Advant® OCS
with Master software

MultiVendor Interface - MODBUS® with MS and CI532V02

Advant® Controller 400 Series

User’s Guide

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Chapter 1 Introduction

1.1 General Information

This manual describes asynchronous communication with the Gould Electronics protocol MODBUS in the ABB Master Advant Controller 400 Series (Advant Controller 410 and Advant Controller 450).

MODBUS in Advant Controller 400 is called MVI-MODBUS (MultiVendor Interface - MODBUS). You can use it for communication with, for example, other manufacturers' control systems (PLCs).

You can use MVI-MODBUS in point-to-point or multidrop type connections. The Advant Controller 400 acts as a master or slave station. MVI-MODBUS is available in RTU (binary) and ASCII mode.
The transmission speed is up to 19200 bits/s.Traffic on the MVI-MODBUS link is controlled by the master station. Direct communication is only possible between the master and the slaves. Stations connected via MVI-MODBUS appear in the ABB Master system as stations in a MasterNet local control network.

This manual tells you how to configure and use MVI-MODBUS from the application programs, that is, the process data base and the PC programs, in the Advant Controller 400.
It is intended primarily for ABB Master application builders, though it is also useful to commissioning and service engineers. To use it, you must be familiar with application building in the Advant Controller 400.

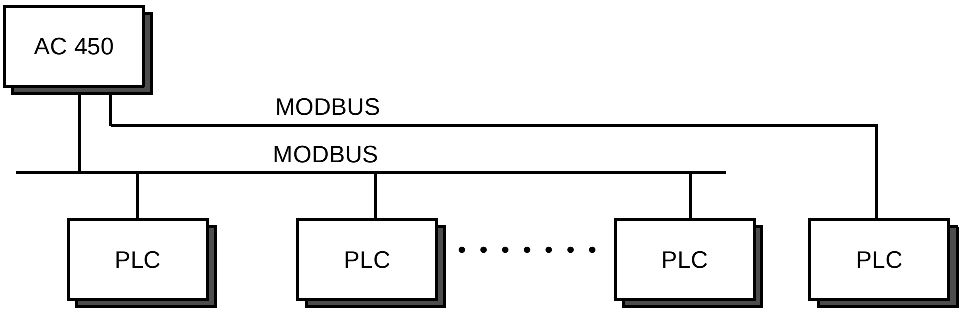


Figure 1-1. Example of a MVI-MODBUS Configuration

1.2 Equipment Requirements

Basic equipment requirements for MVI-MODBUS in the Advant Controller 400 are:

- Communication hardware in the Advant Controller 410
  - **CI532V02**
    Communication submodule for connection of two MVI-MODBUS links.

The communication submodule is connected to one of the four submodule positions on the main processor module PM150.

- Communication hardware in the Advant Controller 450
  - **CI532V02**
    Communication submodule for connection of two MVI-MODBUS links.
  - A free submodule position for the CI532V02 submodule on one of the following submodule carriers:

    SC510
    Carrier without local processor.
    (You can also use one submodule position for other functions, that is, MB 300.)

    SC520
    Carrier with local processor for MB 300.
    (You can also use one submodule position for other functions, that is, MB 300.)

Modems and Cables

The communication submodule CI532V02 is equipped with two independent, CCITT V.24 (RS-232-C), asynchronous communication ports. To connect the MVI-MODBUS link, the following modems and cables are recommended:

- Westermo LA-01 [1]
  Full duplex modem for multidrop communication up to 10 km.
- TC562
  Full duplex modem for cable length up to 10 km. Point-to-point up to 1 km at 19200 bps. Power 24 V d.c.
- Uniline 2.4 [2]
  Modem for point-to-point connection more than 10 km or for switched telephone line.
- TK577
  TK577 is a 3 m cable with a DE9 socket for connection to one port on the front of the CI532V02 submodule and a DE25 PIN for connection to the modem LA-01 or Uniline 2.4.
- TK595
  Cable assemblies DE9 socket DE9 PIN connection to the modem TC562.
- Bus cable with two twisted pairs, each pair individually shielded, minimum conductor area 0.22 mm^2. You can use the following cable or a similar cable:
  - Belden Type 9406
  - Kabelmetal Type DUE 4552
  - Alpha Type 6032
  - Norsk Kabel Type O6802.

---

[1] Ordered from Westermo Teleindustri AB, Stora Sundby, Sweden

[2] Ordered from Standard Radio Telecom AB, Vällingby, Sweden

Engineering Tools

To build the data base and the PC program in the Advant Controller 400, you need an Advant Station 500 Series Engineering Station or an Advant Station 100 Series Engineering Station.

1.3 Manual Organization

Figure 1-2 shows the basic structure of the Advant System's documentation. Each document, describing either hardware or software, is built around this structure to make it easy for you to locate related information in any of the documents.

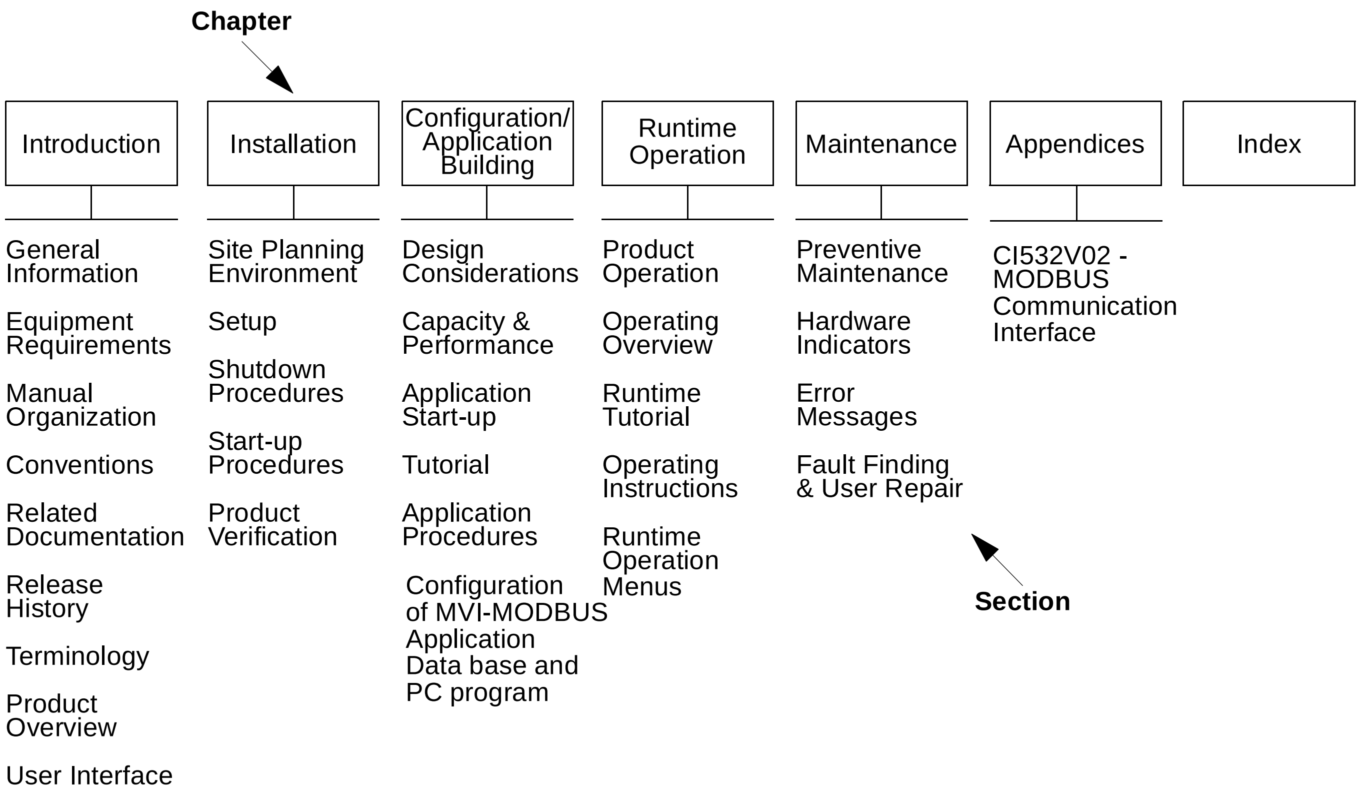


Figure 1-2. Manual Organization Diagram

Introduction

This chapter describes MVI-MODBUS functions in the Advant Controller 400, system layout, hardware requirements, related documents, release history, terminology and the manual's organization.

Installation

Chapter 2, Installation, tells you how to set up the MVI-MODBUS communication hardware in the Advant Controller 400. You will also find descriptions of the shutdown and start-up procedures and how to verify correct operation after you power up.

Configuration and Application Building

Chapter 3, Configuration/Application Building describes how to configure the process data base, define commands for data exchange, store data and build the PC program for flow control on the communication link. You will find capacity and performance figures for the communication and an example of an application program in this chapter. Configuration of Line Characteristics, Network Configuration, MODBUS Register Addresses and using MVI-MODBUS in redundant configuration are also described.

Runtime Operation

In Chapter 4, Runtime Operation, you will find information on how to check the link status and how to activate the application for transmission of commands and data.

Maintenance

Chapter 5, Maintenance translates error messages from the MVI-MODBUS CI532V02 submodule. This chapter also describes a fault-finding procedure.

1.4 Conventions

Following conventions are used in this manual:

- All inputs to data base elements which require you to enter a value are **boldfaced**.
- References to other documents are *italic*.
- Advant OCS is used for Advant Open Control System, with Master software, throughout this manual.

1.5 Related Documentation

Refer to the following documents for further information about application building and MVI-MODBUS functionality.

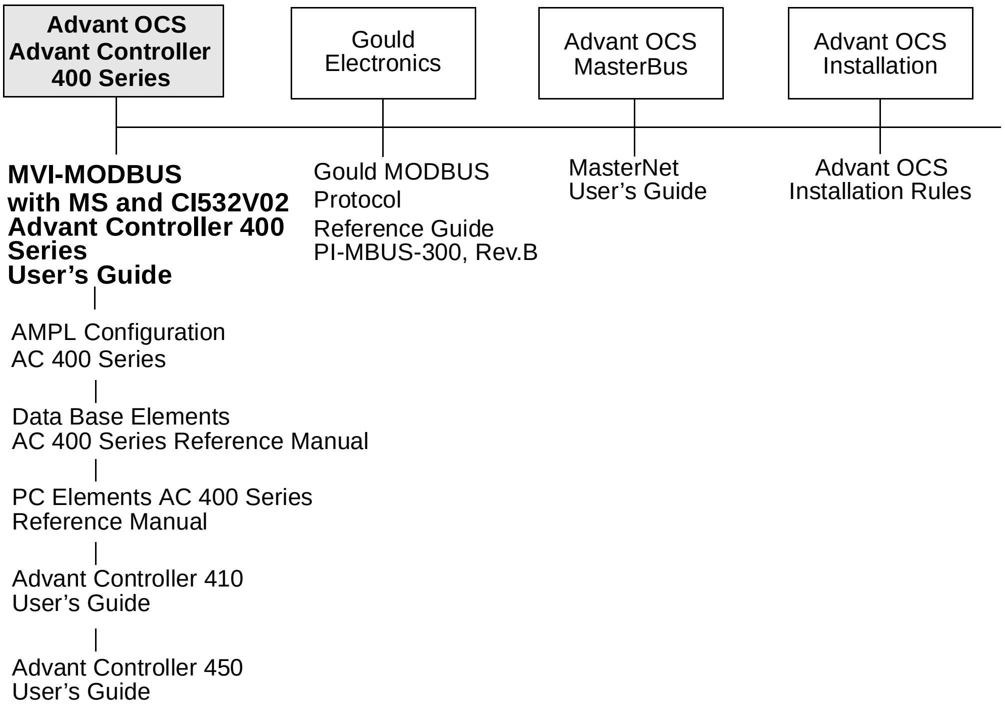


Figure 1-3. MVI-MODBUS and Related Documentation Tree

1.6 Release History

Version	Description
1.0	Initial Release for Advant Controller 400 Series. MVI-MODBUS applications for MP 200/1 can be used in Advant Controller 400 Series.

1.7 Terminology

AC 400 is an abbreviation for the Advant Controller 400 Series
(Advant Controller 410 and Advant Controller 450).

AMPL is an acronym for the ABB Master Programming Language. AMPL is a function-block language with graphic presentation which is especially oriented towards process control. The AMPL is used for configuration and application building in the Advant Controllers.

Controller refers to Advant Controllers.

Command MS is a normal MS (see below) defining the command used to control slaves.
The Command MS is only defined in MVI-MODBUS master mode.

Configuration MS is the MS (see below) used to configure the CI532V02 submodule for the communication.

DAT is a concept in the data base that holds a data value (one Real (4 bytes), one Integer (2 or 4 bytes) or 32 Boolean values). The data values to DS and MS are held by connected DAT elements. ***Note:*** MVI-*MODBUS only supports DAT elements with 2 byte Integers or 32 Boolean values for the Data MS (see below).*

Data MS is the MS used for the actual data transfer.

DS is an abbreviation for Data Set, which is a data base concept in ABB Master. It is used to transfer blocks of data in an ABB Master network.

MB 300/300E or MasterBus 300/300E is a high-speed bus used to interconnect Controllers, Operator Stations and Communication Stations.

MP is an abbreviation for the ABB MasterPiece.

MS is a special type of Data Set used by the MultiVendor Interface (**M**ultiVendor Interface Data **S**et).

MVI is an abbreviation for the Advant OCS Multi Vendor Interface.

PC program (Process Control program) is a program written in AMPL.

PLC is an abbreviation for Programmable Logic Controller (for example, Gould Modicon 484 Controller).

Poll messages (idle traffic) are sent from a MVI-MODBUS master node to the slave nodes when nothing else is transferred on the MVI-MODBUS link (cycle time can be configured). The poll messages are necessary for supervision of the link status. The MODBUS Function code 8 (Diagnostic loop-back) is used as a poll message.

Register Addresses MS (see MS) holds the information for the cross-reference table. The cross-reference table is used to translate the MODBUS Register Addresses to corresponding Data MS (see below) identities in the Advant Controller 400.

A number of different names are used for values handled in the MODBUS protocol. This is a short description of the different names and their meanings:

Table 1-1. Values used in MODBUS

MODBUS	Advant Controller 400
Coil status	Digital output - one Boolean in a DAT(B)
Output status	Digital output - one Boolean in a DAT(B)
Input status	Digital input - one Boolean in a DAT(B)
Holding registers	Analog output - one Integer DAT(I)
Output registers	Analog output - one Integer DAT(I)
Input register	Analog input - one Integer DAT(I)
Single coil	Digital output - one Boolean in a DAT(B)
Multiple coils	Digital outputs - multiple Booleans in a DAT(B)
Multiple registers	Analog outputs - multiple Integer DAT(I)s

1.8 Product Overview

MVI-MODBUS in the Advant Controller 400 provides communication capabilities using multidrop or point to point. Traffic on a MVI-MODBUS link is controlled by a master station. Direct communication is possible only between the master and the slaves. MVI-MODBUS in Advant Controller 400 consists of three parts:

- **PC program** (Process Control program), written in AMPL, is used to define and control the data flow on the link.
- Advant OCS process **data base** is used to configure the communication submodule, CI532V02, and to store the data.
- **CI532V02** communication submodule runs the MVI-MODBUS protocol in the Advant Controller 400.

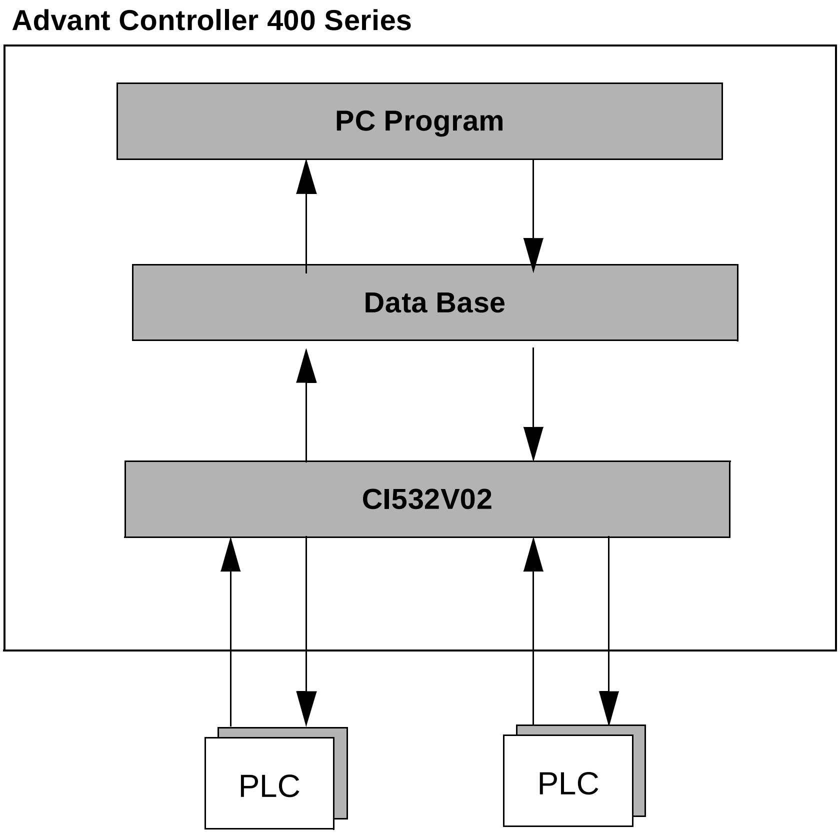


Figure 1-4. Overview of MVI-MODBUS in Advant Controller 400

CI532V02 submodule is installed in the central subrack of the Advant Controller 400. The CI532V02 submodule is equipped with two independent, asynchronous communication ports for MVI-MODBUS communication. You can configure the ports as either master or slave on the MVI-MODBUS link. The setup of each port is individually defined by a number of MS data base elements, see Section 3.6, Configuration of MVI-MODBUS Application Data Base and PC Program.

Each port forms a local control network within the ABB Master system with the network numbers 1 to 9. In master mode, CI532V02 can handle up to eight slaves. Since every PLC on the MVI-MODBUS bus is part of an ABB Master control network, each PLC must have a unique node number, 1 to 99, within the controller concerned.

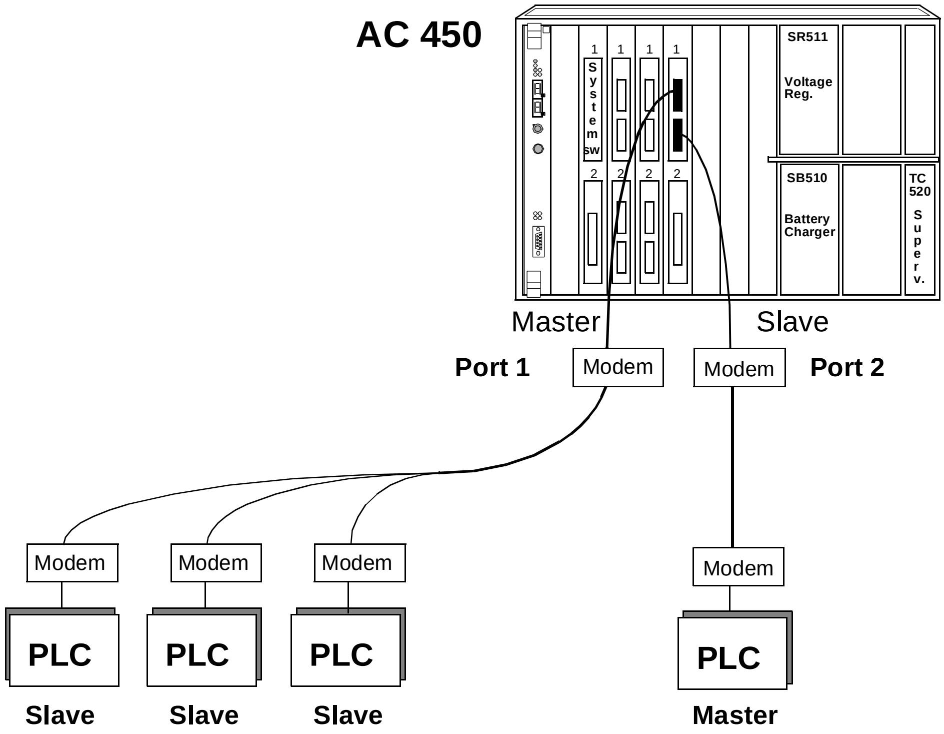


Figure 1-5. MVI-MODBUS Configuration Example

1.8.1 Functionality

The following MODBUS functions are implemented in the CI532V02 submodule:

- **Read output status (Function 1)**
  Update bits in Boolean DATs from a slave.
- **Read input status (Function 2)**
  Update bits in Boolean DATs from a slave.
- **Read output register (Function 3)**
  Update Integer DATs from a slave.
- **Read input register (Function 4)**
  Update Integer DATs from a slave.
- **Force single coil (Function 5)**
  Send one bit in a Boolean DAT to a slave.
- **Preset single register (Function 6)**
  Send one Integer DAT to a slave.
- **Read exception status (Function 7)**
  Get PLC Status (master mode only).
- **Diagnostic loopback (Function 8)**
  Used for idle traffic (poll messages).

- **Force multiple coils (Function 15)**
  Send bits from Boolean DATs to a slave.
- **Preset multiple registers (Function 16)**
  Send Integer DATs to a slave.
- **Exception response (Function code (HEX80+received Function code).**

The MVI-MODBUS implementation is made with both ASCII and RTU (binary) mode (the two ports can work in different modes). The functionality of the protocol is a **subset** of the MODBUS Function codes.

For information about the configuration, refer to Section 3.6.1, MS for MVI-MODBUS Configuration.

For more detailed information about the MODBUS protocol, see manual, *Gould MODBUS Protocol Reference Guide PI-MBUS-300 Rev. D*.

1.8.2 Functional Overview

The application building required in order to use MVI-MODBUS consists of two main parts: The PC program and the data bases (see Figure 1-6).

PC Program

Use the PC program to control the data flow and status of the PLC. All Command MS (see below) are activated from the PC program.

Data Base

The necessary data base input for the CI532V02 submodule is defined with the normal MVI Data Set (MS) used for a special purpose and with the CI532 data base element.

- MS data base is divided into three parts: Configuration MS, Command MS and Data MS.
  - **Configuration MS**

    Data base elements for **Line Characteristics** (defines transmission speed, time-out times, etc.), **Network Configuration** (defines all nodes on the MVI-MODBUS link), ***PLC Status*** (status information for flow control and error indication) and **Register Addresses MS** (holds the information for the cross-reference table on the CI532V02 submodule; the cross-reference table is used to translate the MODBUS register addresses to the Advant Controller 400 Data MS identities).
  - **Command MS**

    Commands to control slaves when the CI532V02 submodule is used in master mode.
  - **Data MS**

    Handles the actual data transfer.
- **CI532**

  The CI532 data base element is used to set up the two ports on the CI532V02 submodule, see Section 2.2, Setup.

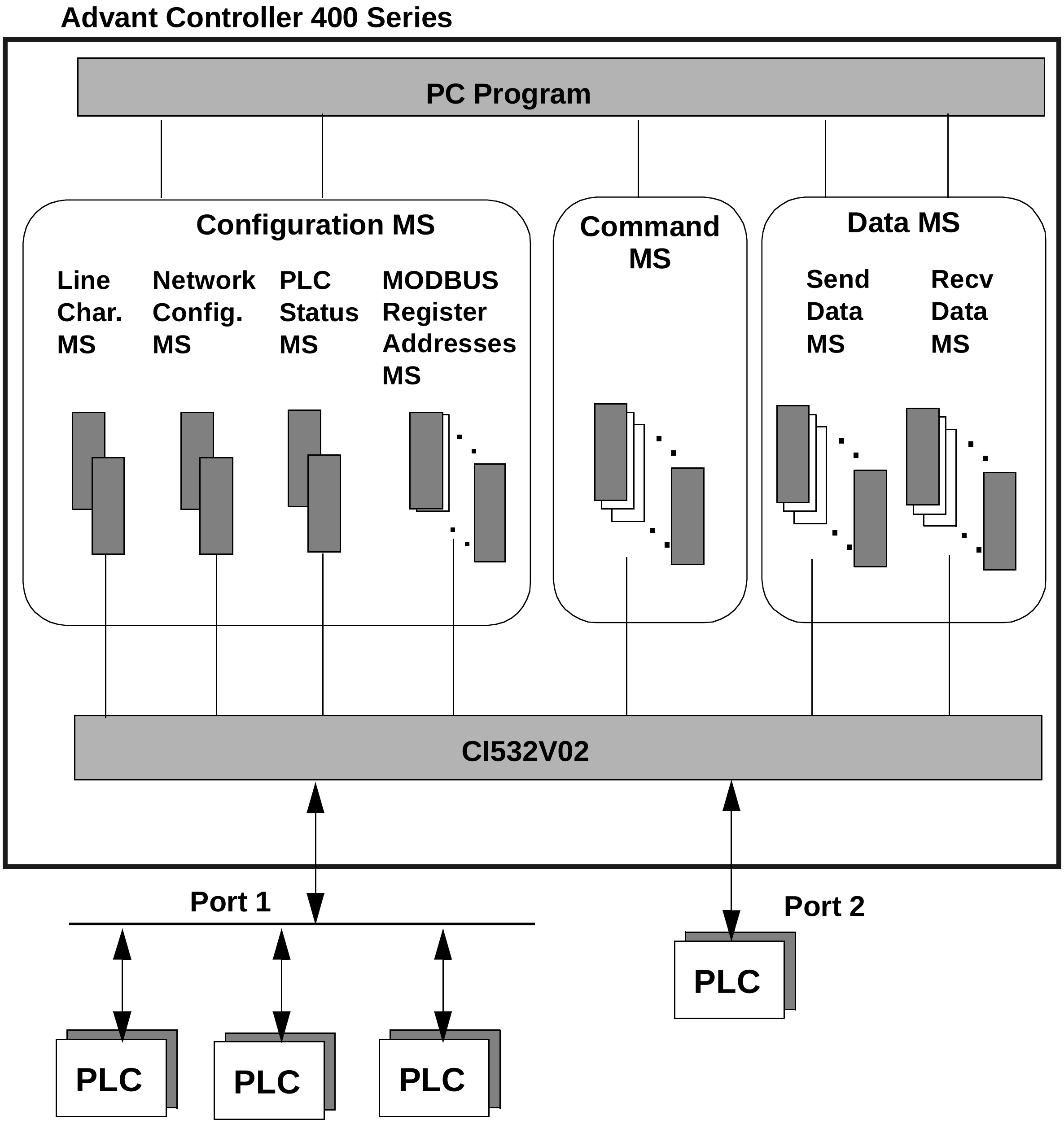


Figure 1-6. Functional Overview in the Advant Controller 400 for MVI-MODBUS

1.8.3 Initiating a Connection

At start-up, all the Configuration MS are automatically requested and sent down to the CI532V02 submodule. The CI532V02 reports application errors if it does not receive all of the necessary Configuration MS or if they contain illegal parameters.

The node is ready for initiation of the connection when the Configuration MS are received, the data base element CI532 for the CI532V02 submodule is correctly set up and the correct modem signals are received from the modem. If full duplex mode is used, Data Set Ready (DSR), Data Carrier Detect (DCD) and Clear to Send (CTS) must be set. The current values of DSR, DCD and CTS are available in the data base element CI532, see Section 2.2, Setup.

The CI532V02 submodule always restarts if the Advant Controller 400 is restarted.

1.8.3.1 Master Mode

The CI532V02 submodule sends a message with Function code 8 to the slaves (that is, a poll message). If the message is responded to with Function code 8 or H'88 (exception response), a connection, ready for data transfer, is established between the CI532V02 submodule and the responding slave. In other cases, there will be no initiation of the connection between master and slave.

In master mode, the CI532V02 submodule always sends poll messages when nothing else is transferred on the link. Poll cycle time is specified in the Line Characteristics MS.

1.8.3.2 Slave Mode

The CI532V02 submodule receives a message from the master. Depending on the address and Function code, the following happens.

- **If the message is addressed to the slave and**
  - Function code = 8:
    The slave initiates the connection with the master and responds with the same message.
  - Function code = 1, 2, 3, 4, 5, 6, 7, 15 or 16:
    The slave initiates the connection with the master and prepares for the next message. The slave does not respond to the first message. The master must do a retransmission in order to execute the command.
  - Other Function codes:
    The slave responds to the master with illegal Function code (exception response). No connection is initiated between slave and master.
- **If all slaves are addressed (broadcast) and**
  - Function code = 5, 6, 8, 15 or 16:
    The slave initiates the connection with the master and prepares for the next message.
- **Other Function codes:**
  The slave does not respond. No connection is initiated between slave and master.

1.8.4 Data Transfer in Master Mode

All data transmission in master mode is handled by a number of Command MS used to define the data to transmit or request. See Section 1.8.4.1, Transmission of Data and Section 1.8.4.2, Request for Data for an overview of these functions.

A maximum of 125 Integer registers (DAT(I), that is, 16 bit Integer) or 2000 Boolean registers (one Boolean in a DAT(B)) can be transmitted on each command. If data from more than one Data MS are transmitted or requested, the MODBUS Register Addresses must be consecutive, see Section 3.6.1.4, Register Addresses MS. It is also possible to transmit only part of an MVI Data Set.

Number of Data MS	Max Number of Integer Registers	Max Number of Boolean Registers
1	24	768
2	48	1536
3	72	2000
4	96	-
5	120	-
6	125	-

For Data MS referenced by a Command MS with IDENT=201, 202, 205 or 215, each DAT element contains 32 Boolean registers. For Data MS referenced by a Command MS with IDENT=203, 204, 206 or 216, each DAT element contains one Integer register.

1.8.4.1 Transmission of Data

The indications **(1), (2), (3),** etc., in the text below refer to identical indications in Figure 1-8.

For the transmission of data from Advant Controller 400 to a MODBUS a a number of Command MS are used to command the CI532V02 submodule to handle the data transfer. The MS with IDENT=205, 206, 215 and 216 (corresponding to the MODBUS Function codes 5, 6, 15 and 16) are used for this purpose.

Each Command MS contains two DATs to define what data and how much to transfer:

- The first DAT element defines the address of the first PLC register to be sent.
- The second DAT element defines the number of PLC registers to be sent (not used for IDENT=205 and 206).

The PC program with the SENDREQ elements activates **(1)** sending of Command MS with a Write Command **(2)** from the Advant Controller 400 to the CI532V02 submodule. The CI532V02 interprets the Write Command to find out which Data MS or part of Data MS to send to the slave.

To find the Data MS containing a certain register address, a cross-reference table is used to translate Register Addresses to corresponding MS identities in the Advant Controller 400. This cross-reference table is defined through a number of Address register MS.
See Section 3.6.1.4, Register Addresses MS.

The CI532V02 submodule requests the referenced Data MS **(3-4)** (this MS must exist in the data base of the Advant Controller 400 as sending MS), converts the data **(5)** to MODBUS format and transmits **(6)** to the destination PLC. The PLC receives the send message **(7)** and sends a reply **(8).**

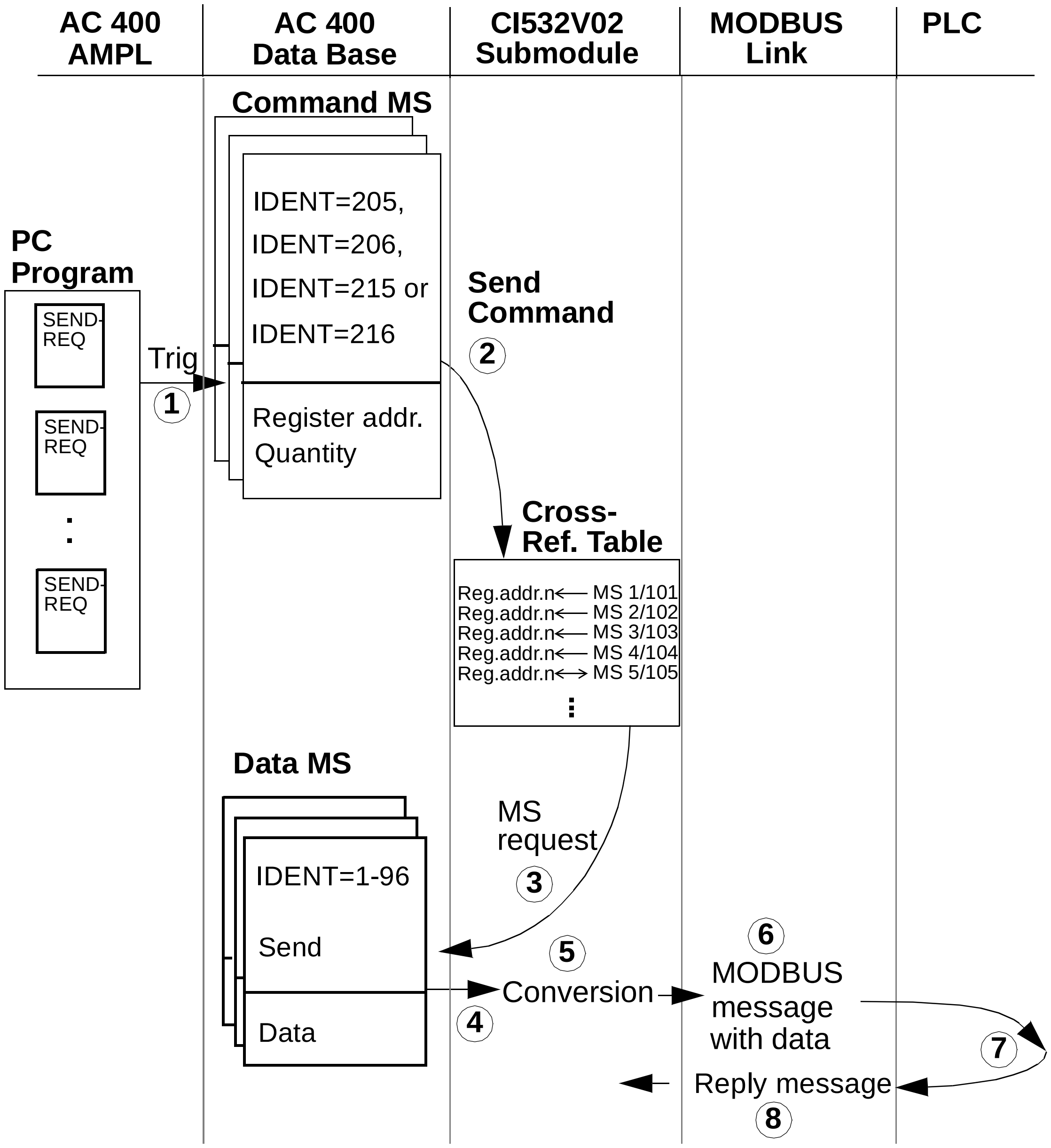


Figure 1-7. Data Transmission in Master Mode, Block Diagram

1.8.4.2 Request for Data

The indications **(1), (2), (3),** etc., in the text below refer to identical indications in Figure 1-8.

To request data from a MODBUS slave to Advant Controller 400, a number of Command MS are used to command the CI532V02 submodule to handle the data request. The MS with IDENT=201, 202, 203, 204 and 207 (corresponding to the MODBUS Function codes 1, 2, 3, 4 and 7) are used for this purpose.

Each Command MS (except Function code 7) contains two DATs to define what and how much data to transfer:

- The first DAT element defines the address of the first PLC registers to be requested.
- The second DAT element defines CPU number of PLC registers to be requested.

Command MS for Function code 7 contains only one DAT, which is always set to zero '0'. The reply is received by the Status MS Status1 VALUE17-VALUE24, see Section 3.6.1.3, PLC Status MS.The PC program with the SENDREQ elements activates **(1)** sending of Command MS with a Read Command **(2)** from the Advant Controller 400 to the CI532V02 submodule. The CI532V02 interprets the Read Command to find out which Data MS or part of Data MS to request from the slave.

To find the Data MS containing a certain register address, a cross-reference table is used to translate register addresses to corresponding Advant Controller 400 MS identities. This cross-reference table is defined through a number of Register addresses MS. See Section 3.6.1.4, Register Addresses MS.

The Read Command MS is converted to a MODBUS read message that is transmitted **(3)** to the MODBUS slave. The PLC receives the Read Command **(6)** and sends a reply with data **(7)**.

NOTE

In order to update only part of an MS, there must always be a sending Data MS (IDENT = 1-96) corresponding to a receiving Data MS (IDENT = 101-196). The sending and receiving Data MS must be connected to the same DAT elements. The reason for this is that CI532V02 requests the MS to allow single DAT mapping, and the only type that can be requested is sending MS.

This sending Data MS is requested by CI532V02 **(4 - 5)** so the received response from the MODBUS slave can be mapped **(8)** into the Data MS before it is sent back **(9)** to the Advant Controller 400.

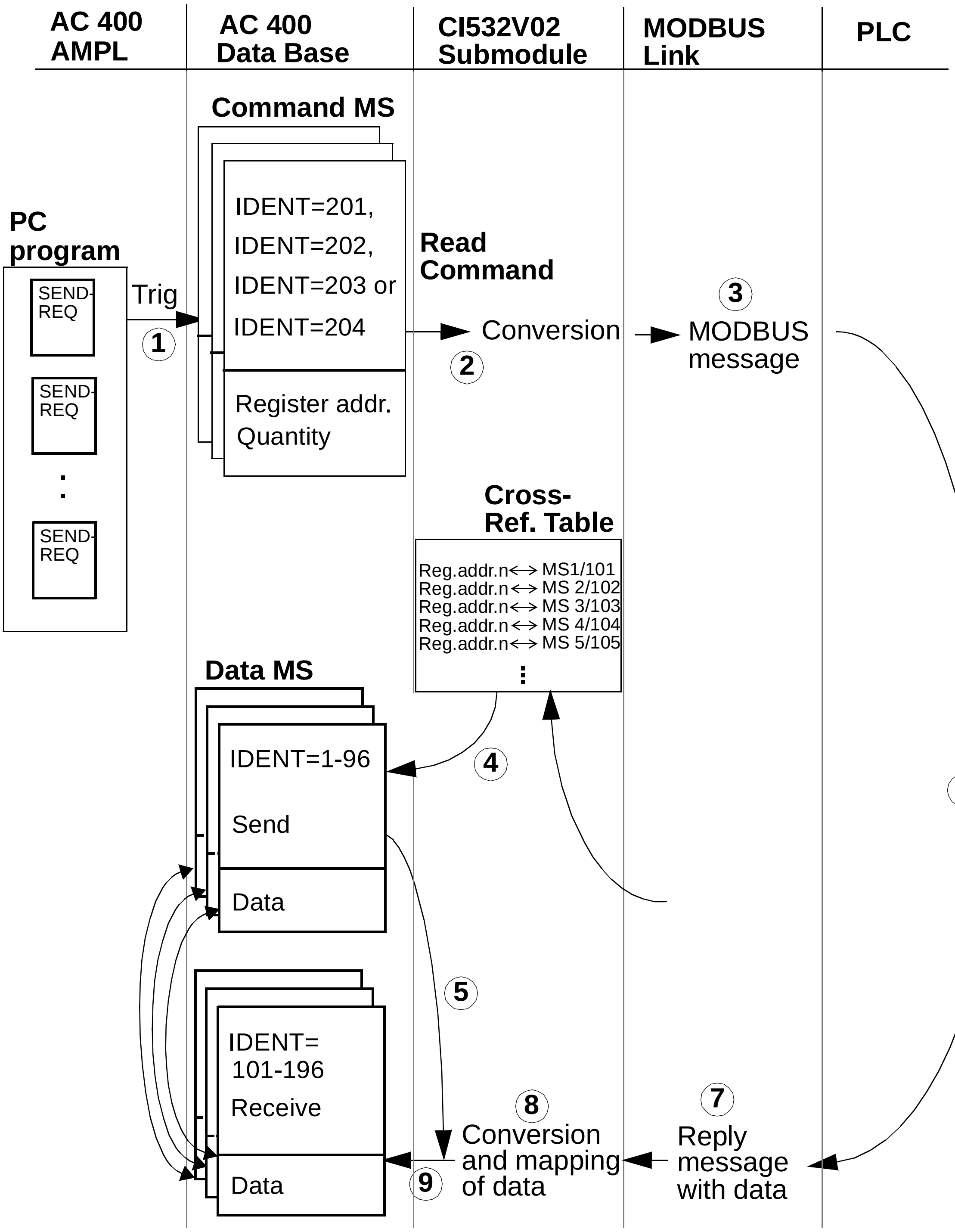


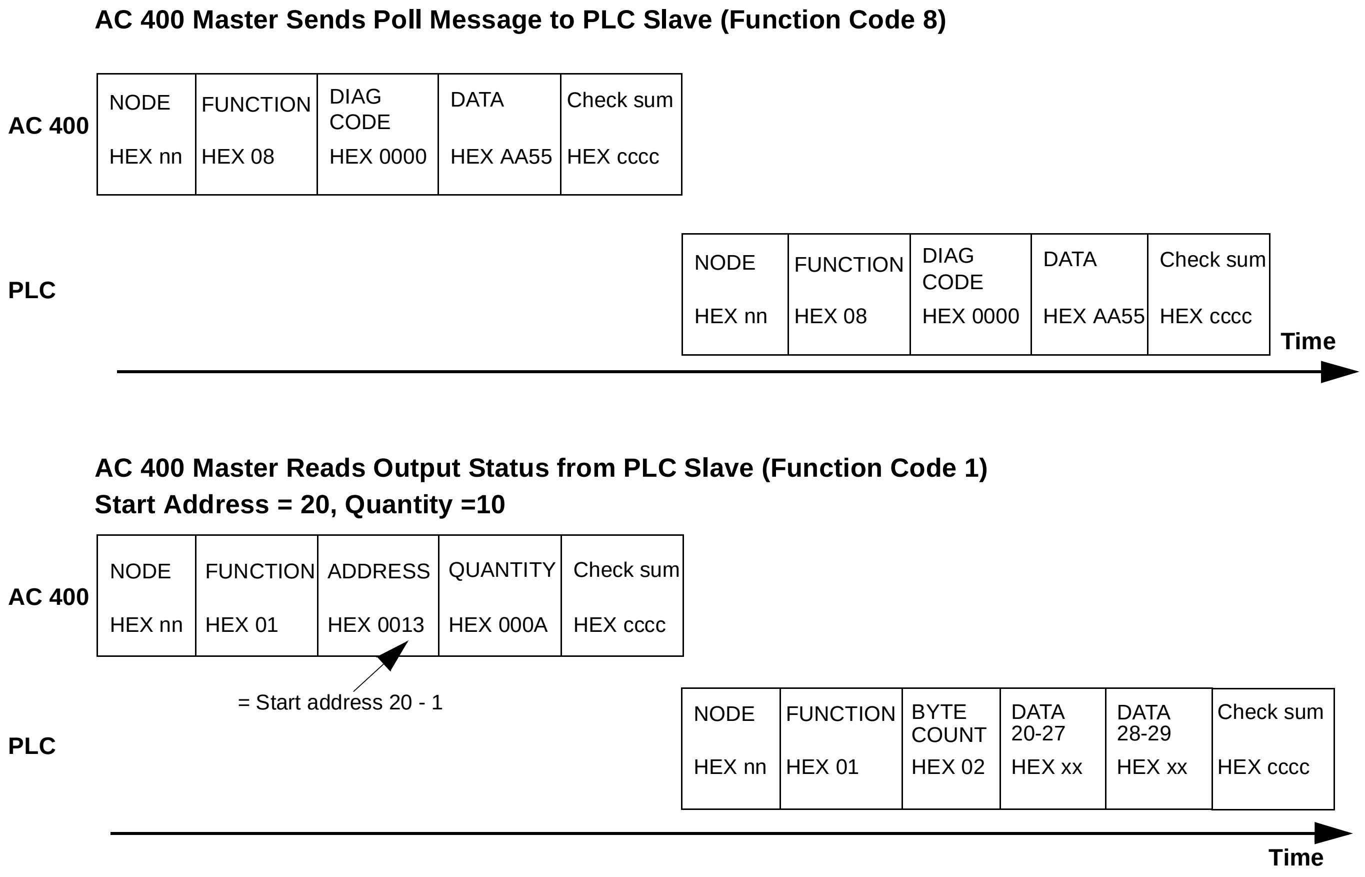
Figure 1-8. Data Reception in Master Mode, Block Diagram

1.8.5 Data Transfer in Slave Mode

All data transmission in slave mode is handled by the master on the MODBUS link. The master writes data to the slave(s) and requests data from the slave(s). It is only necessary to build the Configuration MS, including the Register Addresses MS for the definition of the cross-reference table described in Section 3.6.1.4, Register Addresses MS and the Data MS for transfer of data between the units described in Section 3.6.3, Data MS for Data Transfer, when the CI532V02 submodule is used in slave mode. See Section 3.5.2, Slave Functions.

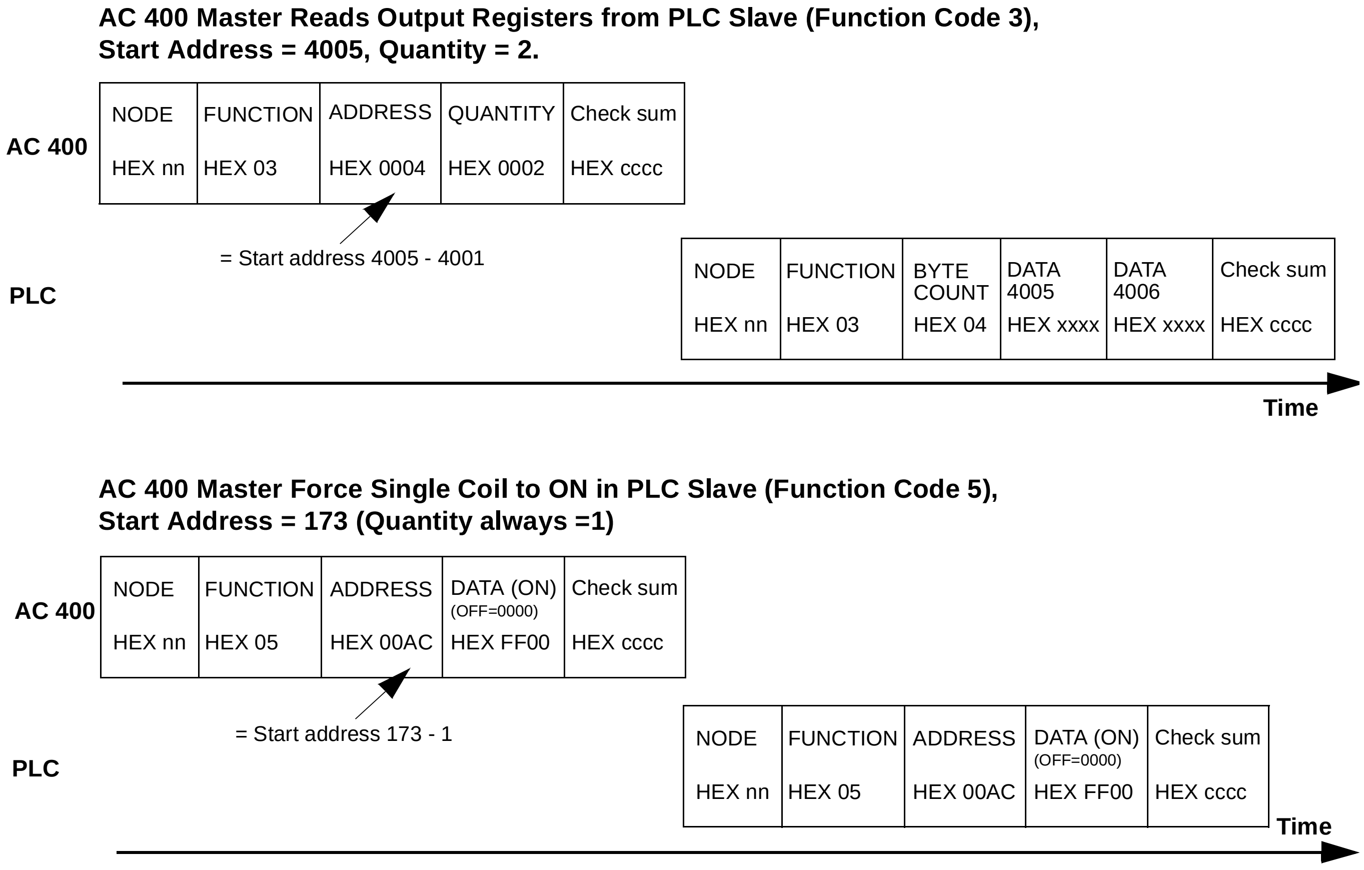
1.8.6 Data Flow on the Link

The following data flow on the link when Advant Controller 400 is the master on the link and sends Function codes 8, 1, 3 and 5 to the slave with node number 'nn'.


AC 400 Master Sends Poll Message to PLC Slave (Function Code 8)

AC 400 Master Reads Output Status from PLC Slave (Function Code 1)
Start Address = 20, Quantity =10

Figure 1-9. Poll Message, Function Code 8 and Function Code 1



AC 400 Master Reads Output Registers from PLC Slave (Function Code 3), Start Address = 4005, Quantity = 2.

AC 400

NODE	FUNCTION	ADDRESS	QUANTITY	Check sum
HEX nn	HEX 03	HEX 0004	HEX 0002	HEX cccc

PLC

NODE	FUNCTION	BYTE COUNT	DATA 4005	DATA 4006	Check sum
HEX nn	HEX 03	HEX 04	HEX xxxx	HEX xxxx	HEX cccc

AC 400 Master Force Single Coil to ON in PLC Slave (Function Code 5), Start Address = 173 (Quantity always =1)

AC 400

NODE	FUNCTION	ADDRESS	DATA (ON) (OFF=0000)	Check sum
HEX nn	HEX 05	HEX 00AC	HEX FF00	HEX cccc

PLC

NODE	FUNCTION	ADDRESS	DATA (ON) (OFF=0000)	Check sum
HEX nn	HEX 05	HEX 00AC	HEX FF00	HEX cccc

Figure 1-10. Function Codes 3 and 5.

1.8.6.1 Flow Control

A PC program controls and checks the data flow on the two asynchronous ports by means of the PC element SENDREQ and status information received from the CI532V02 submodule.

You can block the SENDREQ PC elements through the status bits "Ready for Message" and "Link status" in the status MS for the concerned PLC. The "Ready for Message" flag blocks the SENDREQ PC elements if data flow from the PC program exceeds the capacity of the link. This function automatically controls the flow.

1.8.7 Redundant Bus Handling

The system software in Advant Controller 400 supports redundant MVI-MODBUS communication. The system software automatically handles the switch-over. For more information, see Section 3.6.5, Redundant Configuration.

1.9 User Interface

Not applicable

Chapter 2 Installation

2.1 Site Planning Environment

See the *ABB Master Installation Rules* manual for guidelines on grounding, power supply, etc.

2.2 Setup

The MVI-MODBUS submodule CI532V02 is equipped with two independent, CCITT V.24 (RS-232-C), asynchronous communication ports, see Figure 2-1.

- In Advant Controller 410 the CI532V02 submodule is connected to one of the four submodule positions on the main processor module PM150, see Figure 2-4.
- In Advant Controller 450 the CI532V02 submodule is connected to a free submodule position on one of the following submodule carriers; SC510 or SC520.
  Figure 2-1 shows 2 CI532V02 submodules connected to a SC510 carrier.

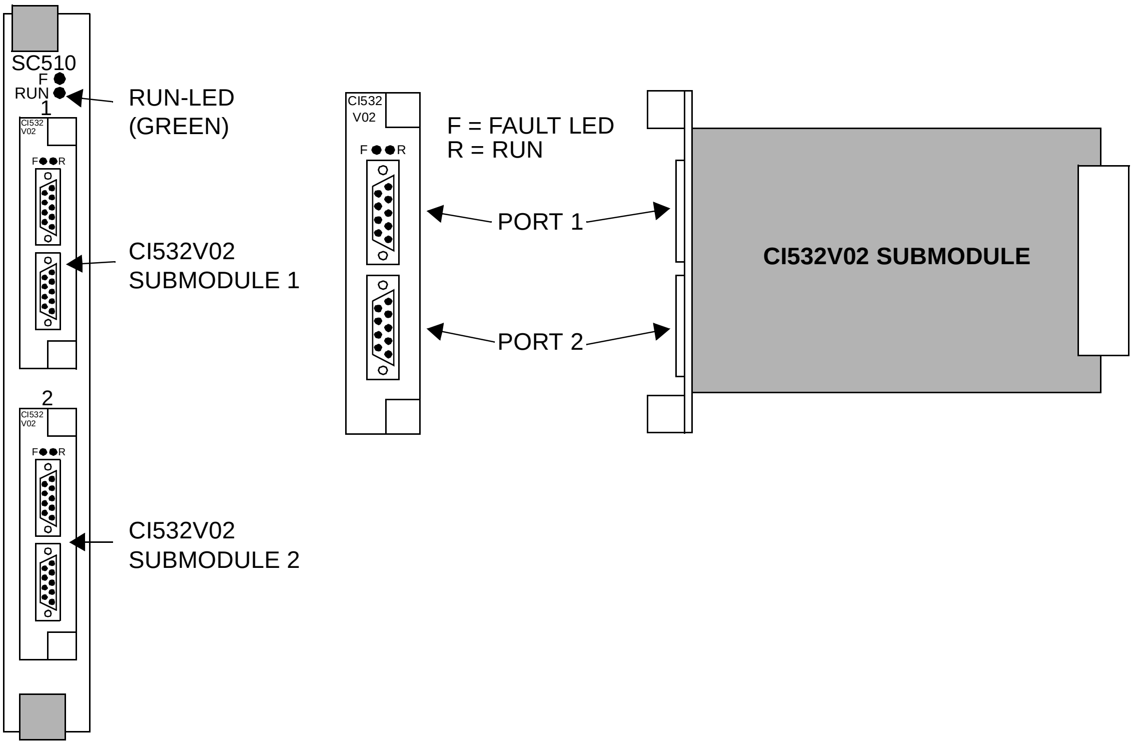


Figure 2-1. SC510 Carrier and CI532 Submodule

MVI-MODBUS communicates with other units in a proprietary, local control network. Valid network numbers for a local control network are 1 to 9. The Advant Controller 400, and every PLC connected to MVI-MODBUS, must have a node number, 1 to 99, which is unique within the connected controller. Modems and cables must be correctly installed. Figure 2-6 shows an example of necessary modems and cables in a MVI-MODBUS point-to-point connection.

The setup for each port on the CI532V02 submodule is made with the data base element CI532[1]. There are no strappings on the CI532V02 submodule and no strappings on the carrier boards SC510 or SC520.

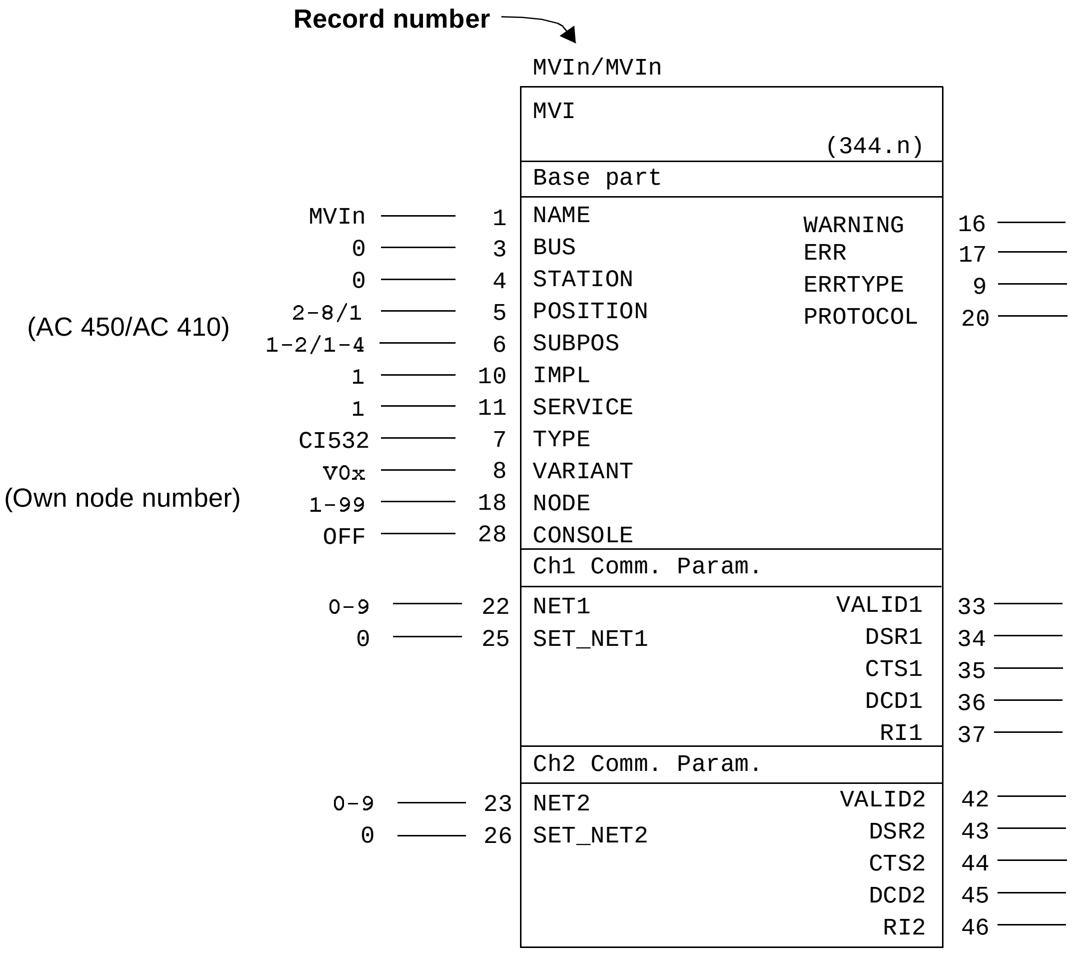


Figure 2-2. Data Base Element CI532 for MVI-MODBUS Communication Submodule CI532V02

You must check or fill in correct values on the CI532 data base element (Element type is MVI and Call name is CI532). For further description, please refer to the *Data Base Elements Advant Controller 400 Series Reference Manual*.

---

1. The call name for the data base element is CI532 and the element type is MVI.

Table 2-1. Properties for the Data Base Element CI532

Terminal	**Value in AC 450**	**Value in AC 410**	**Description**
CI532 Record number	1-5	1-2	CI532V02 submodule number. Record number for the CI532 data base element for the MVI-MODBUS port defines the submodule number. Record no 1 => submodule = 7 Record no 2 => submodule = 8 Record no 3 => submodule = 9 (only valid for AC 450) Record no 4 => submodule = 10 (only valid for AC 450) Record no 5 => submodule = 11 (only valid for AC 450)
1 NAME			Unique NAME of the element.
3 BUS	0	0	Not used
4 STATION	0	0	Not used
5 POSITION	2-8	1	POSITION of the carrier board in the CPU rack, see figure below. To change the POSITION in operation mode, the IMPL must be set to 0. See figure below.
6 SUBPOS	1-2	1-4	SUBPOSition on the carrier board, see figure below. To change the SUBPOS in operation mode, the IMPL must be set to 0. See figure below.
10 IMPL	1	1	IMPLemented =1 to set CI532V02 submodule in normal operation
11 SERVICE	1	1	SERVICE = 1 to set CI532V02 submodule in normal operation SERVICE = 0 to stop the communication on the MVI-MODBUS bus. A change from 0 to 1 means an init of the CI532V02 submodule, that is, the configuration parameters is downloaded to the submodule.
7 TYPE	CI532	CI532	Always CI532
8 VARIANT	V02	V02	V02= MVI-MODBUS
18 NODE	1-99	1-99	Set to AC 400's own node number. If node number of the AC 400 is already defined, NODE can only be set to that node number. In order to modify a node number >0, a COLD START of the AC 400 is necessary.
28 CONSOLE	OFF	OFF	CONSOLE = ON to enable console function on port 2. Used for test purpose.
16 WARNING	0-1	0-1	Warning flag
17 ERR	0-1	0-1	Error flag
9 ERRTYPE	0-n	0-n	Error type. See Section 5.3, Error Messages for translation.

Table 2-1. Properties for the Data Base Element CI532 (Continued)

Terminal	Value in AC 450	Value in AC 410	Description
20 PROTOCOL			Protocol = MVI-MODBUS (Version RTU or ASCII is selected by the set-up of the Line Characteristics MS)
22 NET1 23 NET2	0-9	0-9	Local control NETwork number for port 1 and 2. If SET_NET1 or SET_NET2 =1, the network number is already set for the corresponding port. In order to modify the already set network number, a COLD START of the AC 400 is necessary. All local control network numbers in the AC 400 must be unique. Use NET'n' = 0 if the port 'n' is not used.
25 SET_NET1 26 SET_NET2	0-1	0-1	If SET_NET1 or SET_NET2 =1, the network number has been set for the corresponding port.
33 VALID1 42 VALID2	0-1	0-1	VALID1 = 1 when DSR1, CTS1, etc., are valid. VALID2 = 1 when DSR2, CTS2, etc., are valid.
34 DSR1 43 DSR2	0-1	0-1	Value read from signal Data Set Ready (CCITT V.24 107) for the corresponding port. See NOTE below.
35 CTS1 44 CTS2	0-1	0-1	Value read from signal Clear To Send (CCITT V.24 106) for the corresponding port. See NOTE below.
36 DCD1 45 DCD2	0-1	0-1	Value read from signal Data Carrier Detect (CCITT V.24 109) for the corresponding port. See NOTE below.
37 RI1 46 RI2	0-1	0-1	Value read from signal Ring Indicator (CCITT V.24 125) for the corresponding port. See NOTE below.

NOTE

Displayed values from the CI532 element on the Advant Station 100 Series Engineering Station are not synchronized to the actual value change of the signals; short pulses may not be displayed.

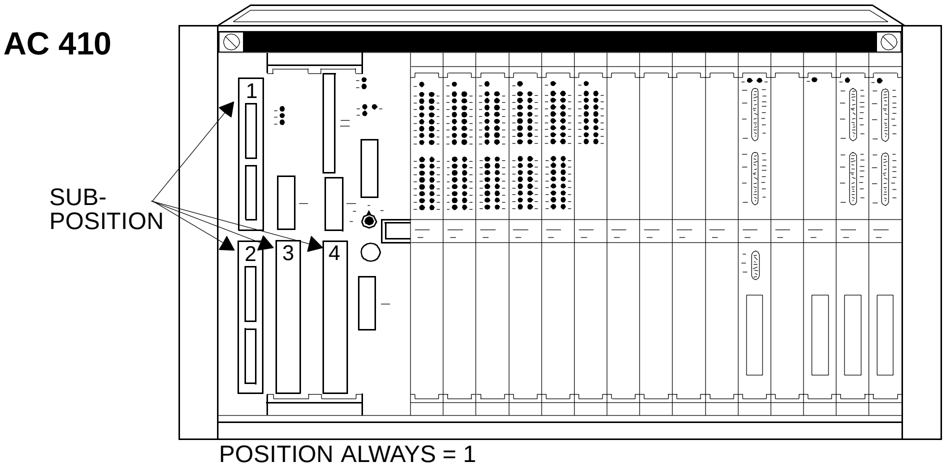


Figure 2-3. Position and Subposition for CI532V02 Submodule in Advant Controller 410

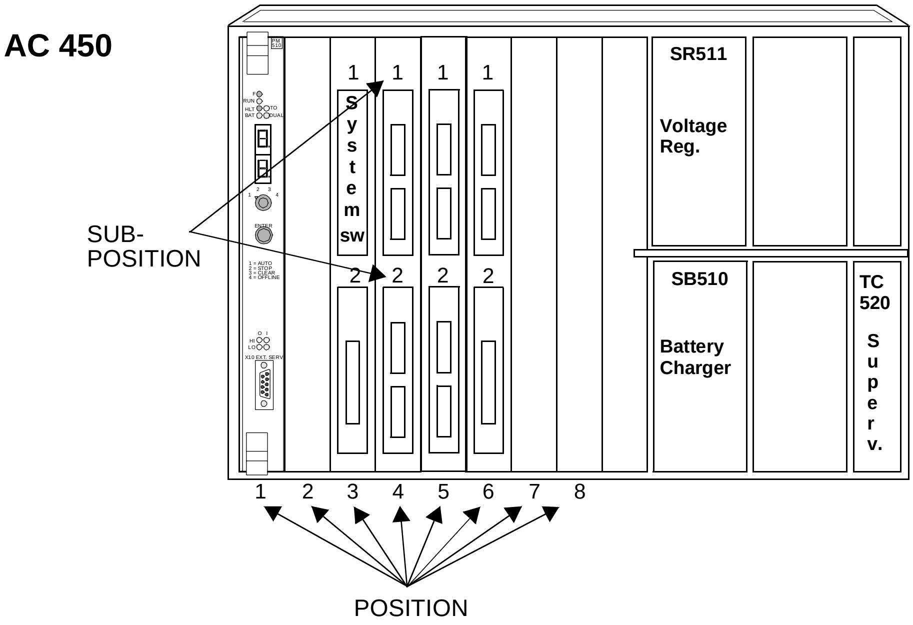


Figure 2-4. Position and Subposition for CI532V02 Submodule in Advant Controller 450

The cable TK577 has a DE9 socket for connection to one port on the front of the CI532V02 submodule and a DE25 PIN for connection to the modem. The connection between the 9- and the 25-PIN connectors is shown in Table 2-2. No wiring of the modem signals is made in the cable TK577. The cable TK595 has a DE9 socket for connection to one port of the CI532V02 submodule and a DE9 PIN for connection to the modem.

Table 2-2. Description of Connections According to CCITT V.24

Description	Signal	No. in 9-PIN Connector	No. in 25-PIN Connector	CCITT V.24	Direction IN ← → OUT
Data Carrier Detect	DCD	1	8	109	←
Receive Data	RD	2	3	104	←
Transmit Data	TD	3	2	103	→
Data Terminal Ready	DTR	4	20	108/2	→
Signal Ground	SG	5	7	102	↔
Data Set Ready	DSR	6	6	107	←
Request To Send	RTS	7	4	105	→
Clear To Send	CTS	8	5	106	←
Ring Indicator	RI	9	22	125	←

If the MVI-MODBUS port is set up for full duplex handling of modem signals, the cable TK577/TK595 can be wired as shown in the Figure 2-5. The setup of modem signals can also be strapped in the modems.

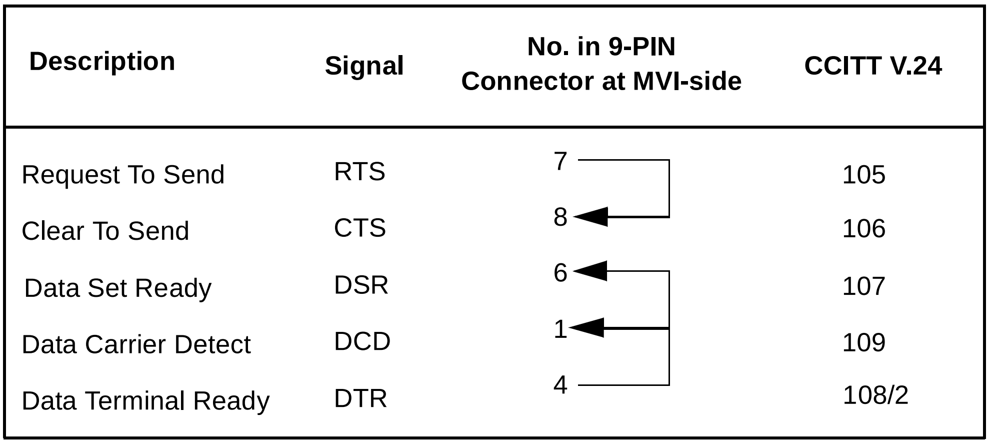


Figure 2-5. Wiring for Full Duplex Handling of Modem Signals.

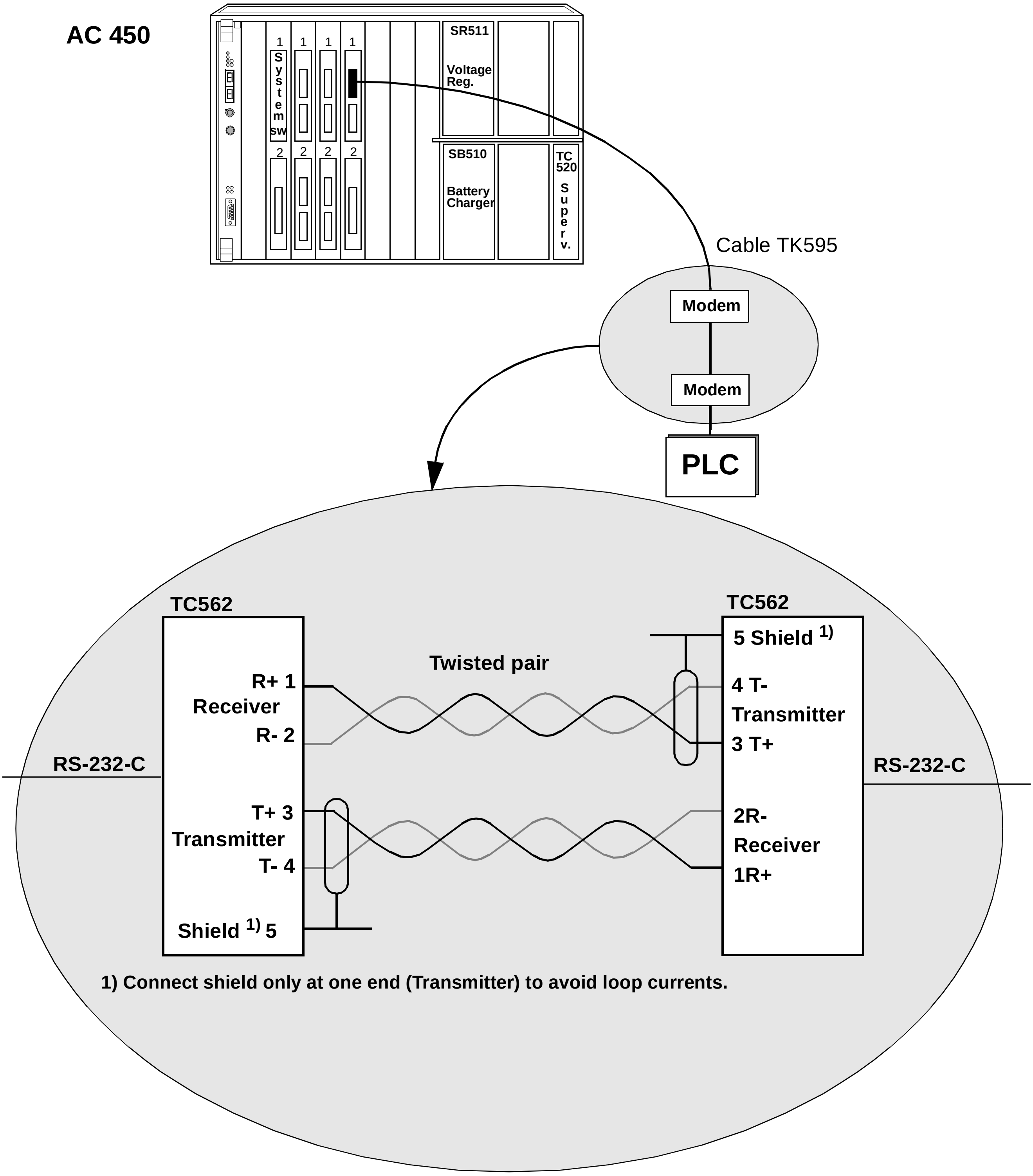


Figure 2-6. Cables and Modems in a MVI-MODBUS Full Duplex Point-to-point Connection

2.3 Shut-down Procedures

Set the terminal SERVICE to 0 on the CI532 data base element to shut down the communication on the link. The communication is also stopped when the Advant Controller 400 is in configuration mode (mode P2, indicated on the front of the main processor module).

2.4 Start-up Procedures

The Advant Controller 400 must be in run-time mode (mode P1, indicated on the front of the main processor module) to communicate on the MVI-MODBUS link. To start up the communication link, you must set up the hardware and the data base element CI532, as described in Section 2.2, Setup. If the parameter NET'n' for port 'n' in the CI532 data base element ≠ 0, the CI532V02 submodule automatically requests all the Configuration MS. See Section 3.5, Application Procedures. The CI532V02 reports application errors if it does not receive all the needed configuration MS.

In master mode, the CI532V02 submodule always sends poll messages when nothing else is transferred on the link.

The CI532V02 submodule always restarts if the Advant Controller 400 is restarted in any way. The CI532V02 also restarts when the terminal SERVICE on the CI532 element is changed from 0 to 1.

Check all the system messages when you restart the CI532V02 submodule. All configuration errors are reported at start-up. Error messages with task name MVIxxx are translated in Section 5.3, Error Messages. Note that some errors are only reported once.

NOTE

If the network number or node number for any of the communication modules in the Advant Controller 400 is changed after the start-up of the node, the Advant Controller 400 must be COLD STARTED. (Connect an Advant Station 100 Series Engineering Station to the Advant Controller 400 and make a DUAP. Press ENTER on the main CPU with start-up switch in "CLEAR" position and make a LOAP.)

2.5 Product Verification

When the CI532V02 submodule is correctly installed and the corresponding CI532 data base element is filled in, the following should be indicated:

- The green LED indicator on the front of the CI532V02 submodule must be lit
- Data base element CI532 Terminal PROTOCOL = MVI - MODBUS.
- Data base element CI532 Terminals ERR and ERRTYPE = 0.

When the link to a PLC is connected and transferring data, the following applies for the DAT element STATUS1 in the PLC-Status MS for the corresponding PLC:

- Link Status (bit 0) = 1
- For more information regarding the PLC Status information, see Section 3.6.1.3, PLC Status MS.

The CI532 element must show the following when the link is connected:

- DSR = 1
- CTS = 1 (full duplex) or toggling between 1 and 0 (half duplex)
- DCD= 1 (full duplex) or toggling between 1 and 0 (half duplex).

Chapter 3 Configuration/Application Building

3.1 Design Considerations

To set up the MS to configure the MVI-MODBUS link, define the following:

- Network structure
  - Local control network number
  - Node numbers for all stations on the MVI-MODBUS bus
  - Point to point or multidrop
  - The master and the slave nodes on the bus.
- Characteristics for the line
  - Transmission speed
  - Character length, number of stop bits, parity and duplex
  - Turnaround time in the PLC (response time for a message)
  - Type of modems.
- PLC Register Addresses
  - Small or large address model (register address 1-999 or 1-9999)
  - Necessary PLC Register Addresses - addresses for input registers, output registers, input status, output status, etc. See Section 3.6.1.4, Register Addresses MS.

If the CI532V02 submodule is configured as the master, you must build the Command MS and the PC program for the control of the data flow on the link. Before you build the Command MS and the PC program, consider the following:

- How are the data transferred from slave to master node?
  - Which Function codes are to be used? See Section 3.5.1, Master Functions and Section 3.6.2, Command MS used in Master Mode.
- To select the cycle time for the PC program, you must know how fast data is to be transferred.

3.2 Capacity and Performance

The maximum number of communication ports and Data MS are:

- Advant Controller 410 can have a maximum of two CI532V02 submodules with totally max of four MVI-MODBUS communication ports.
- Advant Controller 450 can have maximum of five CI532V02 submodules with totally max of nine MVI-MODBUS communication ports.
- Each port on CI532V02 can handle up to 96 MS per PLC.
- Each MS can contain up to 24 DAT elements. Each DAT element in turn can contain one Integer (2 bytes) or 32 Booleans, depending on the Function code entered.

For reasons related to performance and capacity, data that can change simultaneously should be collected into the same MS.

The tables below describe the maximal number of Booleans and Integers that can be associated to one group of Register Addresses. If several groups are used, the combination of the groups and the number of data MS in each group define the maximal number of Booleans and Integers (maximum 96 MVI Data Sets for each PLC).

Table 3-1. Small Address Model

Address Area	Function Code	Max No of Booleans/Integers
0001 - 0999	1, 5, 15	999 (2 Data MS)
1001 - 1999	2	999 (2 Data MS)
3001 - 3999	4	999 (42 Data MS)
4001 - 4999	3, 6, 16	999 (42 Data MS)

Table 3-2. Large Address Model

Address Area	Function Code	Max No of Booleans/Integers
00001 - 09999	1, 5, 15	9999 (14 Data MS)
10001 - 19999	2	9999 (14 Data MS)
30001 - 39999	4	2304 (96 Data MS)
40001 - 49999	3, 6, 16	2304 (96 Data MS)

To calculate the load from the MVI-MODBUS link on the main CPU in the Advant Controller 400, you must consider the following:

- Load from PC program for flow control to the MVI-MODBUS link
- Load from the MVI Data Set communication.

Calculation of load from PC program and Data Set communication is described in the *Advant Controller 400 Series User's Guide.*

3.2.1 Master Nodes

Capacity of a master node:

- Each port on the CI532V02 submodule can handle 8 slave nodes.
- Each master port on the CI532V02 can handle up to:
  - 3 Read or Write Commands per second at a speed of 9600 bits/s.
  - 5 Read or Write Commands per second at a speed of 19200 bits/s.

The capacity is valid for transfer of 1 Data MS (24 Integer or 768 Boolean Registers) and with the recommended cycle time on the PC programs (100 ms) for the data flow control, see Section 3.6.4, PC Program Layout.

If several slave nodes are connected on the MVI-MODBUS bus, the Table 3-3 shows the maximum capacity for each master port on the CI532V02.

Table 3-3. Maximum Number of Read or Write Commands in Master Mode

Number of Registers	Transmission Speed (bits/s)	Max No of Commands/s
768 Boolean (1 MS)	9 600	4
24 Integer (1 MS)	9 600	6
48 Integer (2 MS)	9 600	4
768 Boolean (1 MS)	19 200	5
24 Integer (1 MS)	19 200	8
48 Integer (2 MS)	19 200	5

NOTE

The capacity depends on the load in the Advant Controller 400, the size of the data base in the Advant Controller 400, the response time in the PLC/RTU and the length of the messages.

3.2.2 Slave Nodes

Capacity of a slave node:

- Each port on the CI532V02 submodule can communicate with one node (the Master node).
- The table below shows the maximum capacity for each port on CI532V02 in slave mode.

Table 3-4. Maximum Number of Read or Write Commands in Slave Mode

Number of Registers	Transmission Speed (bits/s)	Max No of Commands/s
768 Boolean (1 MS)	9 600	5
24 Integer (1 MS)	9 600	8
48 Integer (2 MS)	9 600	4
768 Boolean (1 MS)	19 200	6
24 Integer (1 MS)	19 200	10
48 Integer (2 MS)	19 200	5

3.3 Application Start-up

To build the application data base and PC program in the Advant Controller 400, you need an Advant Station 500 or 100 Series Engineering Station (ES). You must do the following before you can start up the communication link:

- Dimension the data base in the Advant Controller 400 (with the command *DIMDB* from the ES). The data base must be dimensioned for MVI Data Set (MS) and DAT. For each port you need:
  - Configuration MS: 4 to 7 MS
  - Command MS: 0 MS in slave mode and 1 to 24 MS in master mode (1 to 3 MS for each slave)
  - Data MS: 1 to 192 MS in slave mode and 1 to 1536 MS in master mode (1 to 192 MS for each slave)
  - Up to 24 DAT elements for each MS. The corresponding sending and receiving Data MS (IDENT = 1 and 101, 2 and 102, 3 and 103, etc.) share the same DAT elements.
- In master mode, the Advant Controller 400 must be dimensioned for PC programs (with the command *DIMPC* from the ES).
- Create the MS data base elements with the command *CRDB MS*. Configure the MS according to the description in Section 3.5, Application Procedures and Section 3.6.1, MS for MVI-MODBUS Configuration to Section 3.6.3, Data MS for Data Transfer. The DAT elements are created automatically when the MS is created. To have the same DAT elements connected to the corresponding sending and receiving Data MS, connect the DAT elements from the sending Data MS to the receiving Data MS or vice versa (write in the name of the DAT on the terminal REFn on the MS when you configure the MS).
- Fill in the correct values for the DAT elements with the command *MDB 'DAT name'*.
- In master mode, build a PC program as described in Section 3.6.4, PC Program Layout.
- When the application data base and PC program are ready, you can start up the communication link as described in Section 2.2, Setup.

3.4 Tutorial

The indications **(A), (B), (C),** etc., in the text below refer to identical indications in the figures describing the data base and PC program in this example.

This example describes the necessary application programming and data base in the Advant Controller 450 master for Writing 24 Integer DATs from the master to two slave nodes and Reading 24 ***(V)*** Integer DATs from the same two slaves. The same range of MODBUS Register Addresses is used for both the slave nodes. The register address 4001 **(A)** is for the Write Command (Function 16) **(B)** and 3001 **(C)** is for the Read Command (Function 4) **(D)**. In this example, one of the slave nodes is an Advant Controller 410. The application program for the Advant Controller 410 slave node is also described.

The configuration of the link is made for multidrop connection, modbus PLC **(E)** and small address model **(F)**.

Data on the Advant Controller 450 Master Node: (G)

- CI532V02 submodule number = 7 (CI532 Record number = 1) **(H)**
- Node number = 10 (= PLC number for PLC1 in Advant Controller 410 slave node) **(J)**
- Network number = 4 **(K)** CI532 module in POSITION = 4 and SUBPOSITION = 2 **(L)**
- Only port 1 used.

Data on the Slave Node: (M)

- CI532V02 submodule number = 7 (CI532 Record number = 1) **(N)**
- Node number = 15 (= PLC number for PLC1 in Advant Controller 450 master node) **(O)**
- Network number = 4 **(P)**
- CI532 module in POSITION = 1 and SUBPOSITION =4 **(Q)**
- Only port 1 used.

Data on the PLC Slave Node: (R)

- Node number = 16 (= PLC number for PLC2 in Advant Controller 450 master node) **(S)**
- Network number = 4 **(T)**

Data on the Modems:

- Transmission speed 9600 bits/s, full duplex **(U)**

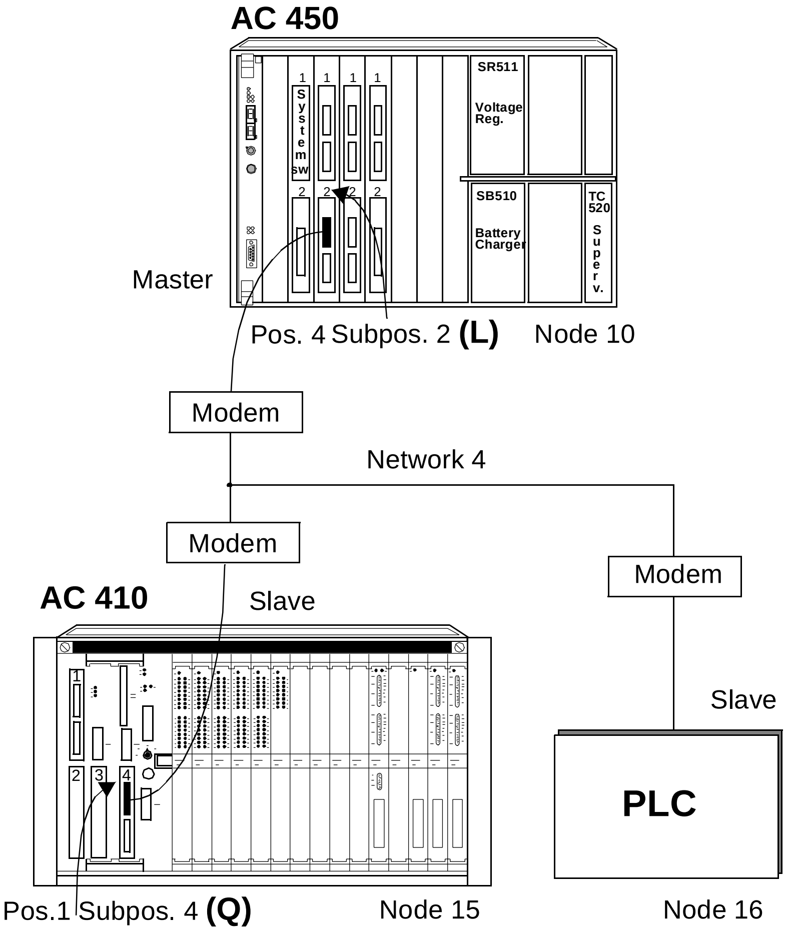


Figure 3-1. Configuration for the Example

3.4.1 Application in Advant Controller 450 Master Node

3.4.1.1 Data Base in Advant Controller 450 Master Node

- The **CI532** data base element must be set up correctly
- Four **Configuration MS** must be built in the application data base:
  - Line Characteristics
  - Network Configuration
  - Register Addresses
  - PLC Status MS
- No **Command MS** is used.
- One **Command MS** is used to **read data** from the slave node.

- Three **Data MS** for each slave node are used for the actual data transfer. One Sending Data MS (IDENT = 1) is used for the Write Command. For the Read Command, one sending Data MS (IDENT = 2) and one receiving Data MS (IDENT = 102) are used. The Data MS for the Read Command share the same DATs.

Definition for the CI532V02 Submodule

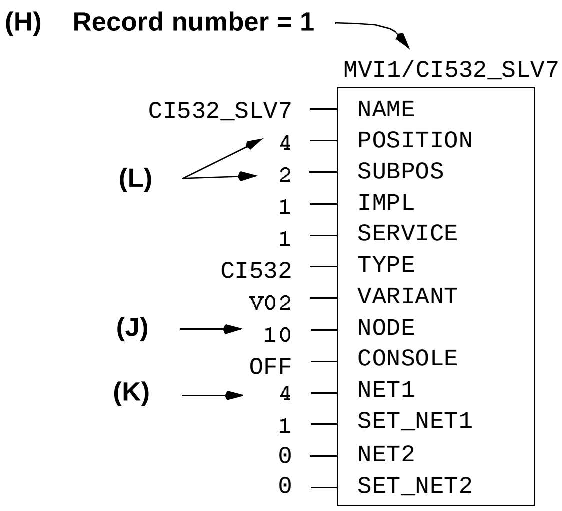


Figure 3-2. CI532 Data Base Element for Master Node

The terminal NODE is always -3 for the Configuration MS. NET is a reference to the CI532V02 submodule. The Record number for the CI532 data base element defines the network number for the Configuration MS (NET), according to the table below.

Table 3-5. Network Number for Configuration MS in Advant Controller 450

CI532 Record No.	Configuration MS Network No.
1	7
2	8
3	9
4	10
5	11

Configuration of the Communication Line

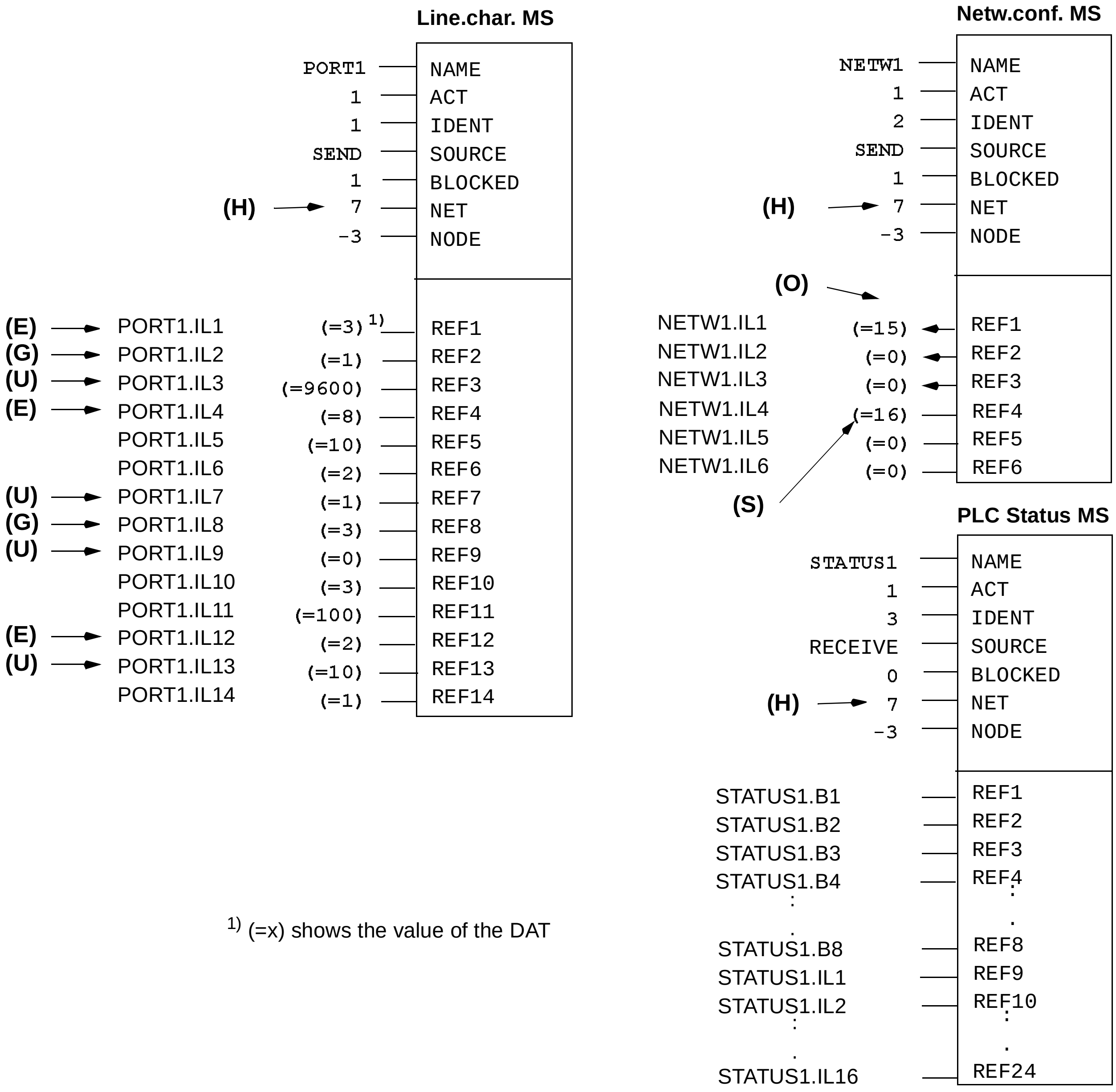


Figure 3-3. Line Characteristics MS, Network Configuration MS and PLC Status MS in Master Node

Definition for Register Addresses and Commands

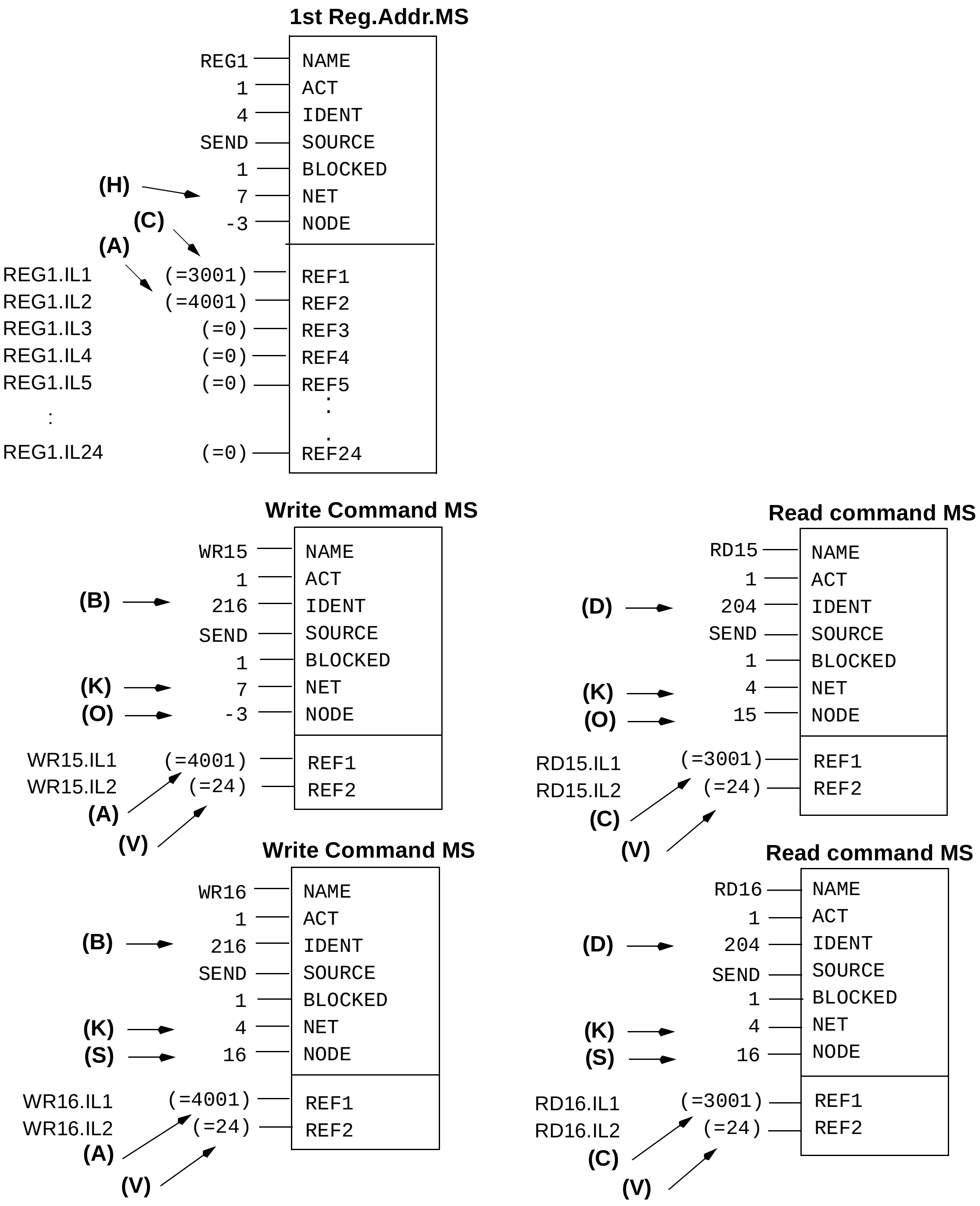


Figure 3-4. Register Addresses MS and Command MS in Master Node

The terminal NODE and NET number on the Register Address MS is the same as for the other Configuration MS.

Definition for Data Transfer

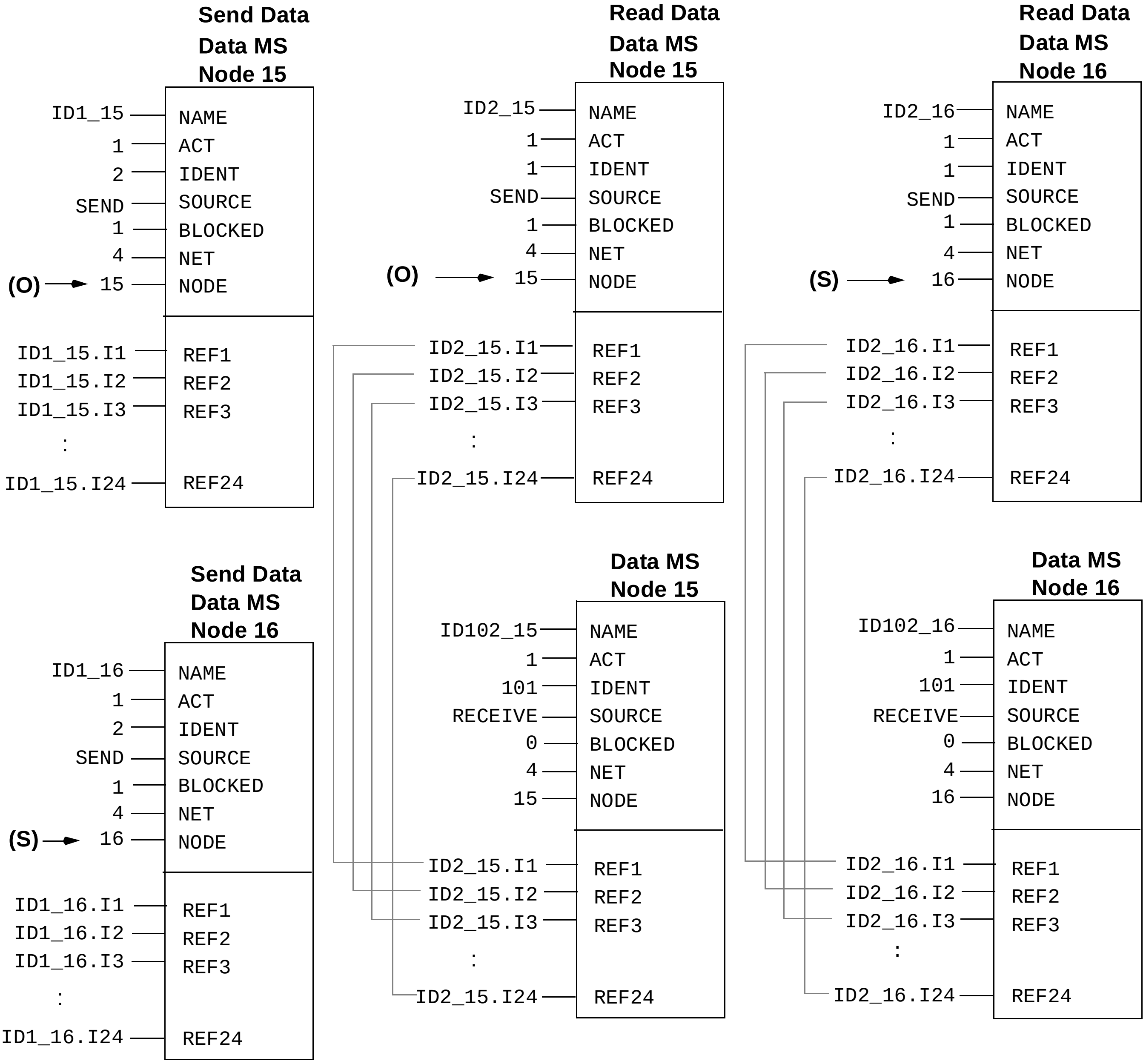


Figure 3-5. Data MS in Master Node for Slave Node 15 and 16

For each slave node, one sending Data MS (IDENT = 2) is used for the Write Command. For the Read Command, one sending Data MS (IDENT = 1) and one receiving Data MS (IDENT = 101) are used. Data MS with IDENT = 1 and 101 corresponds to MODBUS Register Addresses 3001 - 3024 (Start address 3001 connected to REF 1 in first Register Address MS) and the Data MS with IDENT = 2 corresponds to MODBUS Register Addresses 4001 – 4024. The Data MS for the Read Command share the same DATs. The Send and Receive Data MS have NET and NODE defined as the network and node number to the slave node.

NOTE

In order to allow update of only a part of an MS, there must always be a sending MS (IDENT = 1-96) corresponding to a receiving MS (IDENT = 101-196). The sending and receiving Data MS are connected to the same DAT elements. When the CI532V02 submodule receives data from the PLC, the corresponding sending Data MS is requested from Advant Controller 400. The received data from the PLC is mapped into the data from the sending Data MS before it is sent back to the receiving Data MS in the Advant Controller 400 Series.

3.4.1.2 PC Program in Advant Controller 450 Master Node

The PC program is designed to send one Write Command and one Read Command each second. The Link status (STATUS1.B1:VALUE)and Ready for Message (STATUS1.B1:VALUE6) are fetched from the PLC Status MS.

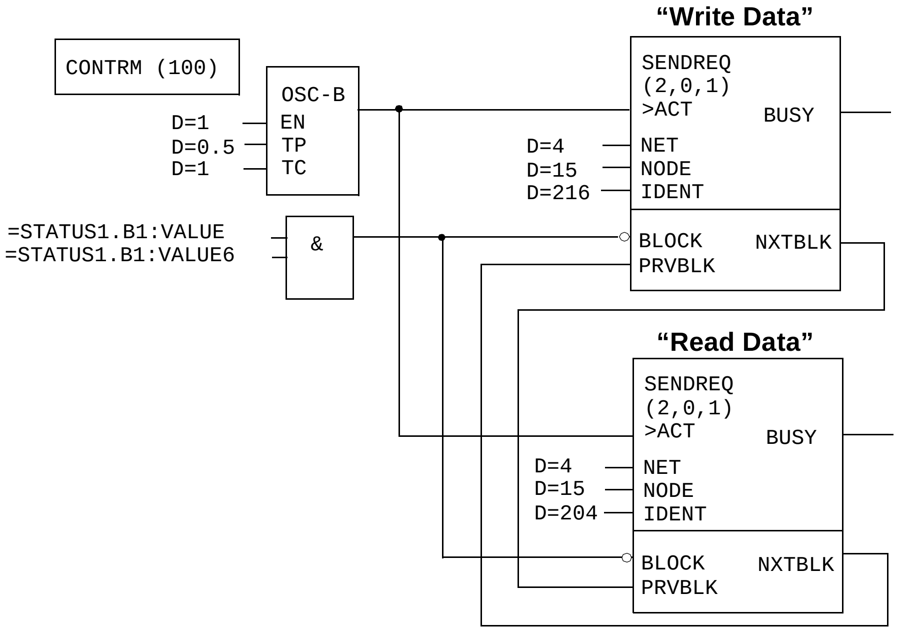


Figure 3-6. PC Program for Sending Data to Slave Node 15

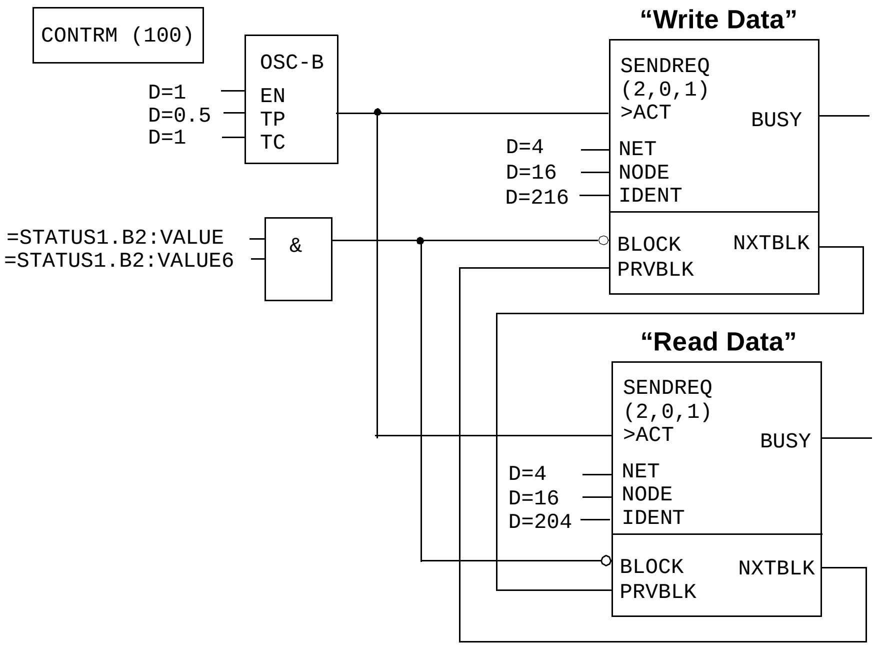


Figure 3-7. PC Program for Sending Data to Slave Node 16

3.4.2 Application in Advant Controller 410 Slave Node

3.4.2.1 Data Base in Advant Controller 410 Slave Node

- The **CI532** data base element must be set up correctly.
- Four **Configuration MS** must be built in the application data base: Line Characteristics, Network Configuration, Register Addresses and PLC Status MS.
- No **Command MS** is used.
- Three **Data MS** are used for the actual data transfer. One for **Sending Data** MS (IDENT = 1) and one **Receiving Data** MS (IDENT = 101) are used for the Write Command. For the Read Command, one sending Data MS (IDENT = 2) is used. The Data MS for the Write Command share the same DATs.

Definition for the CI532V02 Submodule

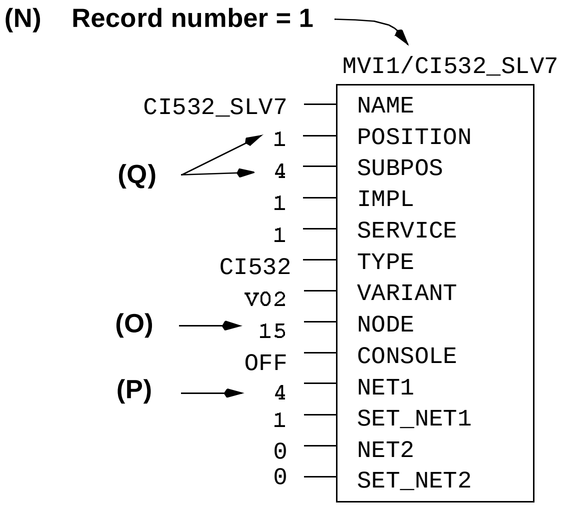


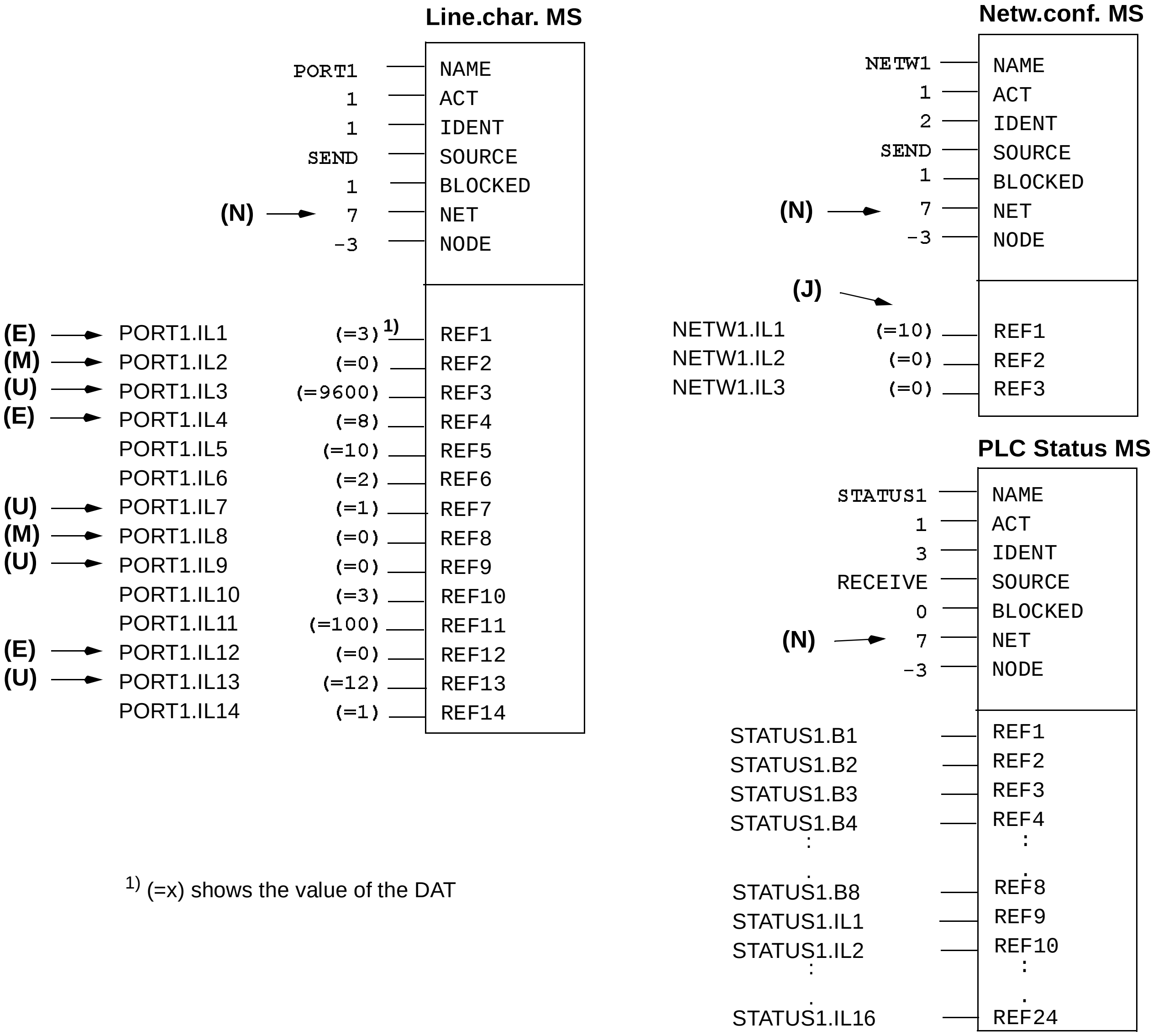
Figure 3-8. CI532 Data Base Element for the Slave Node

The terminal NODE is always -3 for the Configuration MS. NET is a reference to the CI532V02 submodule. The Record number for the CI532 data base element defines the network number for the Configuration MS (NET), according to the table below.

Table 3-6. Network Number for Configuration MS in Advant Controller 410

CI532 Record No.	Configuration MS Network No.
1	7
2	8

Configuration of the Communication Line



[1] (=x) shows the value of the DAT

Figure 3-9. Line Characteristics MS, Network Configuration MS and PLC Status MS in the Slave Node

Definition for Register Addresses

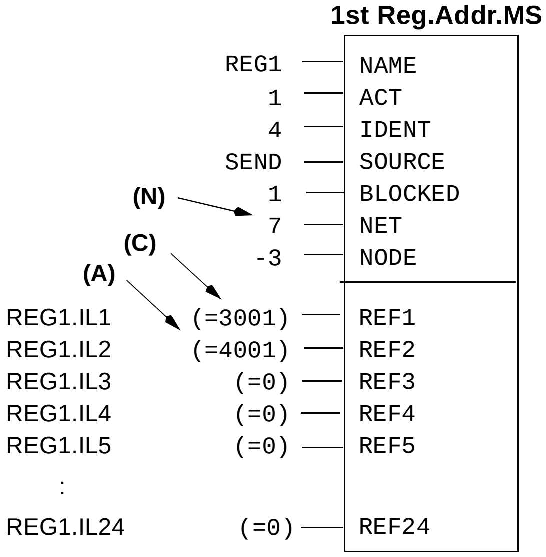


Figure 3-10. Register Addresses MS in the Slave Node

The terminal NODE and NET number on the Register Address MS is the same as for the other Configuration MS.

Definition for Data Transfer

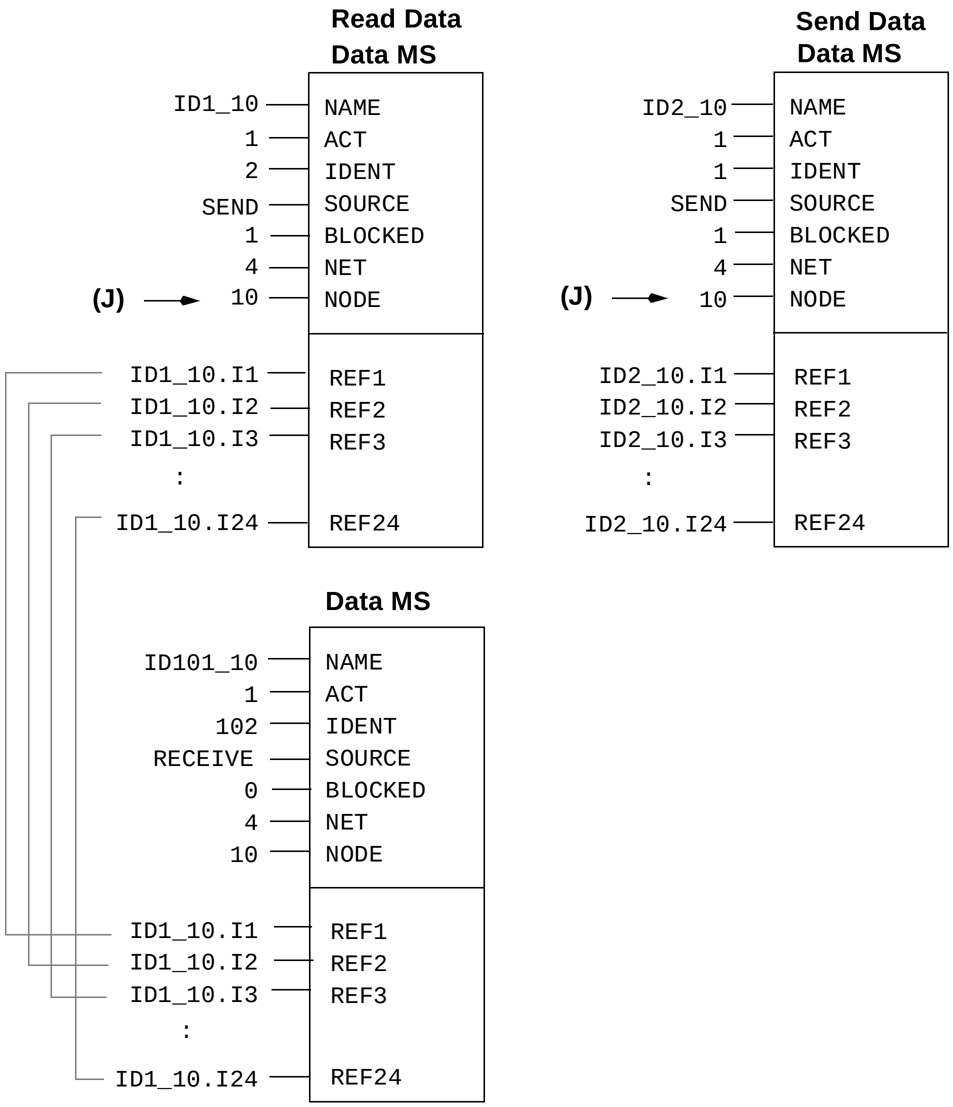


Figure 3-11. Data MS in the Slave Node

Three Data MS are used for the actual data transfer. One sending Data MS (IDENT = 2) and one receiving Data MS (IDENT = 102) are used for the Write Command. One sending Data MS (IDENT = 1) is used for the Read Command. The Data MS with IDENT = 1 corresponds to MODBUS Register Addresses 3001 - 3024 (Start address 3001 connected to REF 1 in first Register Address MS). The Data MS for the Write Command share the same DATs. The Data MS with IDENT = 2 and 102 corresponds to MODBUS Register Addresses 4001 - 4024. The Send and Receive Data MS have NET and NODE defined as the network and node number to the master node.

3.4.2.2 PC Program in Advant Controller 410 Slave Node

No **PC program** is necessary in the slave node.

3.5 Application Procedures

This is a summary of the steps you must take to build the application data base and PC program for the MVI-MODBUS communication in the Advant Controller 400. See Section 3.6, Configuration of MVI-MODBUS Application Data Base and PC Program for a detailed description of the MVI-MODBUS application.

1. Answer the questions described in Section 3.1, Design Considerations:
   - Network structure
   - Line characteristics
   - Function codes to be used for the data transfer
   - Register Addresses to be used
   - Cycle time for PC program.
2. Build the Configuration MS:
   - Line Characteristics MS (always necessary)
   - Network Configuration MS (always necessary)
   - Register Addresses MS (at least one MS necessary)
   - PLC Status MS (always necessary).
3. Build Command MS:

   The Command MS are used only in master mode. One Command MS is used for each slave and for each Function code.
   - Read Command MS
   - Write Command MS.
4. Build MS for data transfer:
   - Sending Data MS
   - Receiving Data MS.

NOTE

In order to update only a part of an MS, there must always be a sending MS (IDENT = 1-96) corresponding to a receiving MS (IDENT = 101-196).
Sending and receiving Data MS must be connected to the same DAT elements.

5. Build PC program for flow control:
   - The PC program is only necessary in master mode.

PC Program

Use the PC program to control the Command MS if CI532V02 is used in master mode. The PC program is not necessary in slave mode.

The PC program controls and checks the data flow through the asynchronous port by means of the PC element SENDREQ and status information received from the CI532V02 submodule. The SENDREQ element activates the Command MS and the Data MS (see below). All SENDREQ PC elements used for Command MS to the same PLC must be included in the same control module (CONTRM). The PC program is described in Section 3.6.4, PC Program Layout.

Data Base

The necessary data base input for the CI532V02 submodule is defined in MVI Data Sets (MS) and the CI532 data base element.

- MS data base is divided into three parts: Configuration MS, Command MS and Data MS.
  - **Configuration MS**

    The configuration MS **must always be defined.** If they do not exist when you start up the CI532V02 submodule, application errors are reported.

    Line Characteristics MS: MVI-MODBUS line characteristics (i.e., transmission speed, time-outs, etc.), one for each communication port. The MS is described in Section 3.6.1, MS for MVI-MODBUS Configuration.

    Network Configuration MS: Defines node numbers for all PLC nodes connected to the MVI-MODBUS network. One MS is used for each communication port. Section 3.6.1.2, Network Configuration MS describes the Network Configuration MS.

    Register Addresses MS: Holds the information for the cross-reference table on the CI532V02 submodule. The cross-reference table is used to translate the MODBUS Register Addresses to corresponding Data MS identities in the Advant Controller 400. One to four MS must be built for each port. See Section 3.6.1.4, Register Addresses MS for a description of how to fill in the cross-reference table.

    Status MS: Receive status information for flow control and error indication used by the PC program and updated by CI532V02. One Status MS is used for each port. Section 3.6.1.3, PLC Status MS describes the Status MS.
  - **Command MS**

    MS used for various commands to control slave nodes. The Command MS are only defined in the MVI-MODBUS master node. See Section 3.6.2, Command MS used in Master Mode.
  - **Data MS**

    MS used for the actual data transfer between the PC program PLC. There are two types of Data MS: Sending MS and Receiving MS. See Section 3.6.3.1, Data Transmission to a PLC and Section 3.6.3.2, Data Transmission from a PLC, respectively.
- **CI532**

  The CI532 data base element is used to set up the two ports on the CI532V02 submodule, see Section 2.2, Setup.

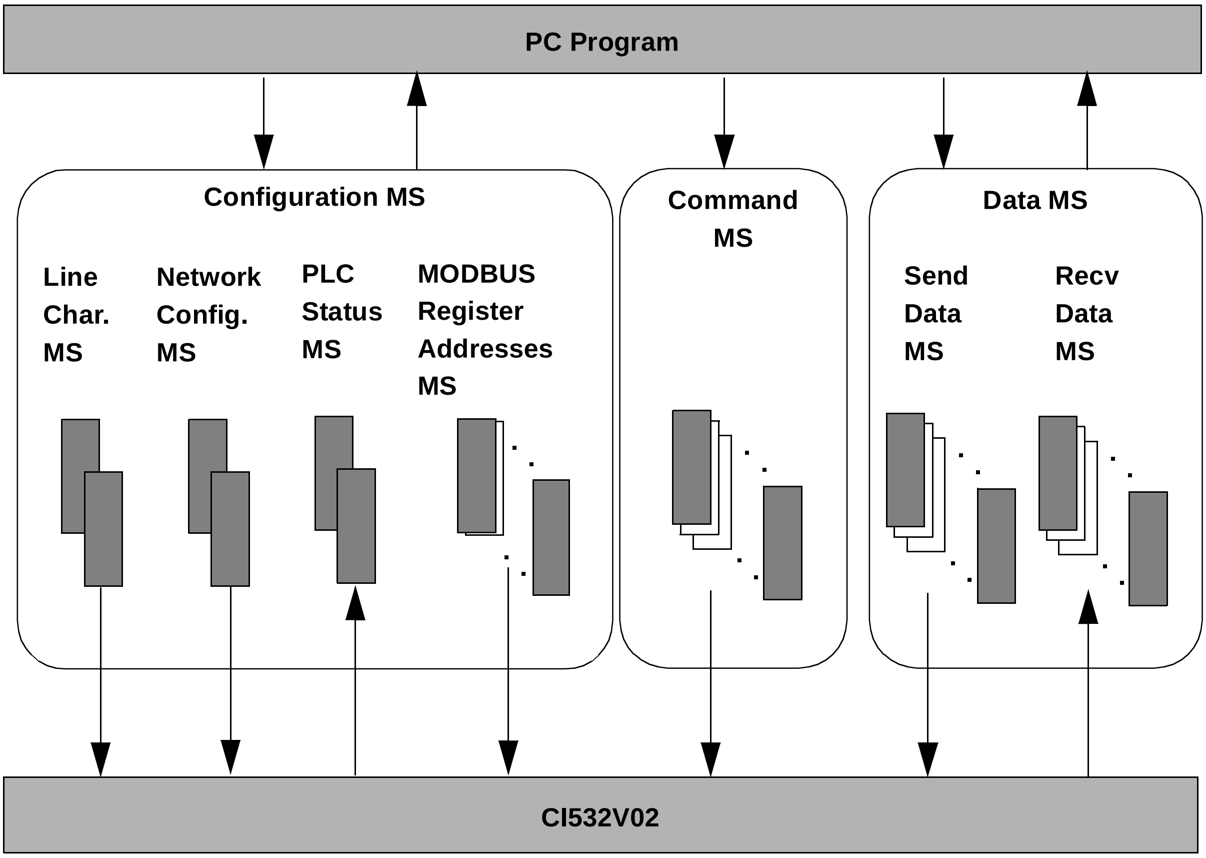


Figure 3-12. Overview Layout of the Application for MVI-MODBUS

3.5.1 Master Functions

The functions mentioned below can be defined/controlled at the **application** level in master mode:

- **Read output status (Function 1)**

  Read Command MS (IDENT = 201)

- **Read input status (Function 2)**

  Read Command MS (IDENT = 202)

- **Read output registers (Function 3)**

  Read Command MS (IDENT = 203)

- **Read input registers (Function 4)**

  Read Command MS (IDENT = 204)

- **Force single coil (Function 5)**

  Write Command MS (IDENT = 205)

- **Preset single register (Function 6)**

  Write Command MS (IDENT = 206)
- **Read exception status (Function 7)**

  Read Command MS (IDENT = 207)
- **Force multiple coils (Function 15)**

  Write Command MS (IDENT = 215)
- **Preset multiple registers (Function 16)**

  Write Command MS (IDENT = 216).

Broadcast is not handled by the master.

See Section 3.6.3.1, Data Transmission to a PLC for a description of the Write Command MS and Section 3.6.3.2, Data Transmission from a PLC for a description of the Read Command MS.

3.5.2 Slave Functions

It is not necessary to define any functions at application level in slave mode. Only the Configuration MS described in Section 3.6.1, MS for MVI-MODBUS Configuration and the Data MS for sending and receiving data have to be defined. Function code 7 is not implemented in slave mode. For this reason, a call for this function is replied to with the error message "Illegal Function code" (H'87).

3.6 Configuration of MVI-MODBUS Application Data Base and PC Program

3.6.1 MS for MVI-MODBUS Configuration

This section describes the Configuration MS used to configure the CI532V02 submodule. These MS contain setup information for the CI532V02's hardware and software. Status information is also received from CI532V02. The Status information can be used by the application program.

3.6.1.1 Line Characteristics MS

Line Characteristics are specified in one MS for each asynchronous communication port, which CI532V02 reads during its start-up/restart and start-up of Advant Controller 400. The application program can also initiate a port by sending Line Characteristics MS with the SENDREQ PC element.

NOTE

Line Characteristics MS is always blocked at runtime. If not, MVI-MODBUS communication software restarts each time the submodule receives it. The submodule must be restarted (see Section 2.4, Start-up Procedures) if references in the Network Configuration MS are changed (see Section 3.6.1.2, Network Configuration MS). Sending the Line Characteristics MS to the CI532V02 submodule for new initiation of the port is **not** enough.

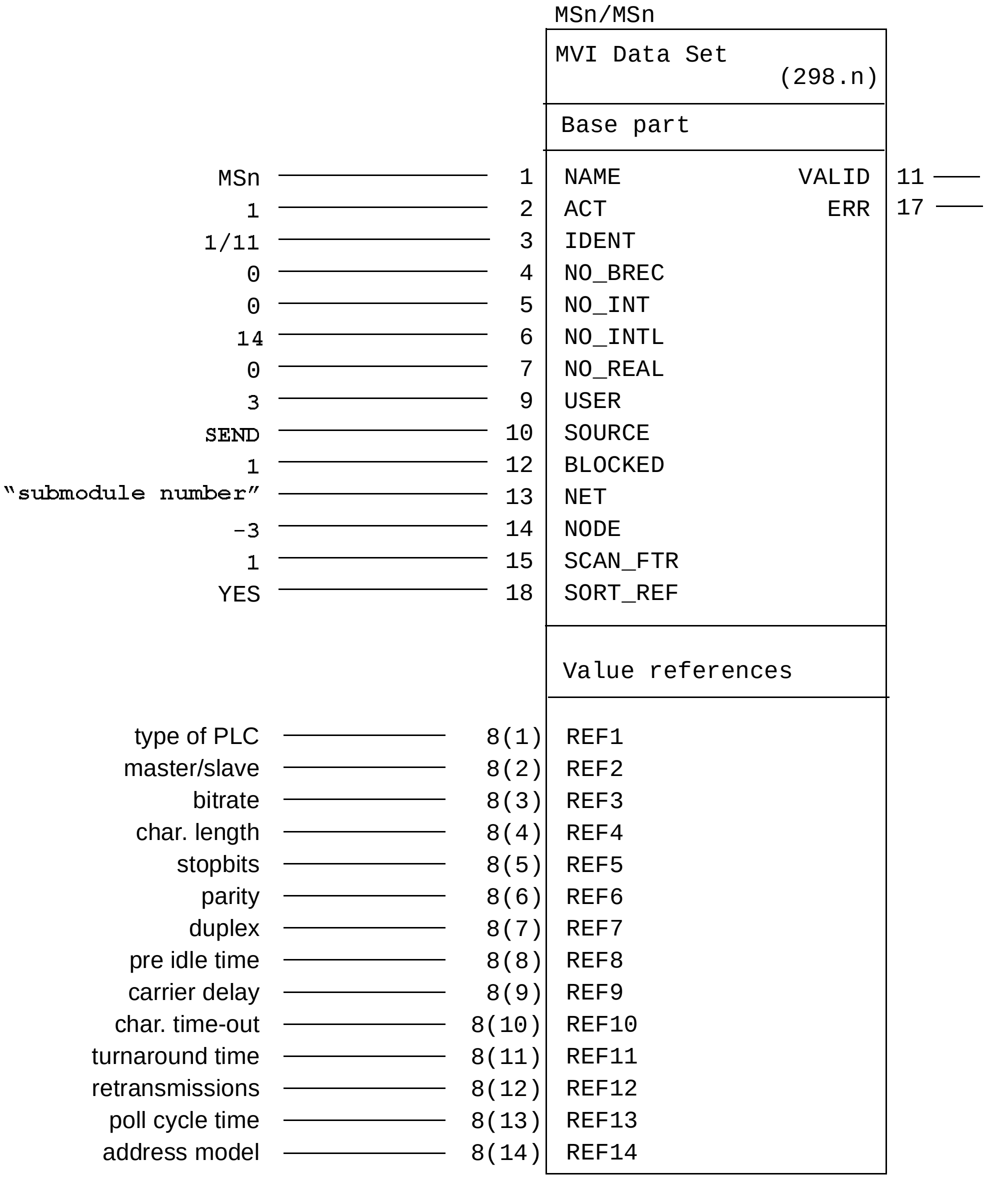


Figure 3-13. MVI Data Set for Line Characteristics

The parameters REF1 - REF14 are stored in the DAT elements referenced by the Line Characteristics MS. You can give DAT elements arbitrary names.

Table 3-7. Description of MS for Line Characteristics

Terminal	Parameter Name	Recommended Value (Min-Max)	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT		1 or 11	Identity of the MVI Data Set 1 for port 1, 11 for port 2
NO_BREC		0	
NO_INT		0	
NO_INTL		14	Number of Integer Long DAT references
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note:** The MS must be blocked. MS requested by the CI532V02 module at start-up.
NET		7 - 11	CI532V02 submodule number. Record number for the CI532 data base element for the MVI-MODBUS port defines the submodule number. Record no 1 => submodule = 7 Record no 2 => submodule = 8 Record no 3 => submodule = 9 (only valid for AC 450) Record no 4 => submodule = 10 (only valid for AC 450) Record no 5 => submodule = 11 (only valid for AC 450)
NODE		-3	Always -3 for Configuration MS
SCAN_FTR		1	Without function when BLOCKED=1
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID			1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.
REF1	Type of PLC	3 or 4	3 = MODBUS RTU (Binary code) 4 = MODBUS ASCII
REF2	Slave/Master	0 or 1	0 = The port is a Slave 1 = The port is a Master
REF3	Bitrate		Transmission speed: 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 bits/s.
REF4	Character Length	7 ASCII mode 8 RTU mode (Binary)	The number of bits/character

Table 3-7. Description of MS for Line Characteristics (Continued)

Terminal	Parameter Name	Recommended Value (Min-Max)	Description
REF5	Stopbits	10	5 = 0.5 stop bits 10 = 1 stopbit 15 = 1.5 stopbits 20 = 2 stopbits
REF6	Parity	2	0 = No parity 1 = Odd parity 2 = Even Parity
REF7	Duplex	1	0 = Half duplex handling of modem signals. 1 = Full duplex handling of modem signals (Normal setting) 2 = Half duplex and ignore DCD.
REF8	Pre-idle time	3 for RTU mode 1 for ASCII mode, half duplex 0 for ASCII mode, full duplex	Pre-idle time in number of character transmission times. Time to allow the carrier wave to stabilize before transmission of the first character. Restrictions for half duplex: "(own) pre-idle time ≥ (opposite side) post-idle time". See also Figure 3-14 below.
REF9	Post-idle time	0 for full duplex 1 for half duplex	Post-idle time in number of character transmission times. Time to wait after the transmission of the last character before deactivating RTS. This delay is used to avoid destruction of the last character in the message, due to lost carrier. See also Figure 3-14 below.
REF10	Char Time-out	3 (0 - 255)	The number of characters to wait until the message is considered interrupted. Char Time-out time in number of character transmission times. Used by receive routine to detect idle receive line. 0 = No check for time-out is made.
REF11	Turnaround time	100 (5 - 1000)	Time in milliseconds to wait from the last character in the command until the first character in the reply, i.e., time-out time, where the master waits for a response from the slave node. **Note:** This time is dependent on the times defined in REF8 and REF9 (or corresponding set-up) in the slave node and must be adjusted accordingly. You must also include delays that may occur in the slave units. See also Figure 3-15.
REF12	Retransmissions	2 for Master 0 for Slave (0 - 200)	Max. no. of retransmissions before the line is considered broken.

Table 3-7. Description of MS for Line Characteristics (Continued)

Terminal	Parameter Name	Recommended Value (Min-Max)	Description
REF13	Poll cycle time	96000 / Bitrate for Master 1.2*96000/Bitrate for Slave (5 - 770)	Max. allowed time in seconds between two polling cycles. In slave mode, the slave disconnects the link when this time between polls is exceeded.
REF14	Address model	0 Large 1 Small	Defines the address model. The addresses 0XXXX, 1XXXX, 3XXXX and 4XXXX correspond to the large model (XXXX = 1 - 9999). The addresses 0XXX, 1XXX, 3XXX, and 4XXX correspond to the small address model (XXX = 1 - 999).

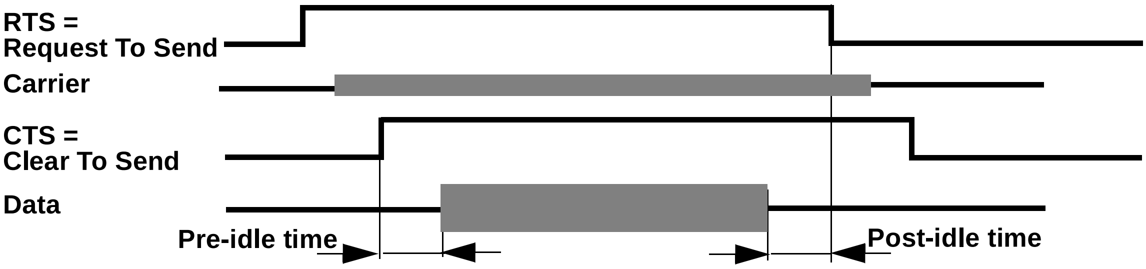


Figure 3-14. Pre-idle Time and Post-idle Time in Half Duplex Mode

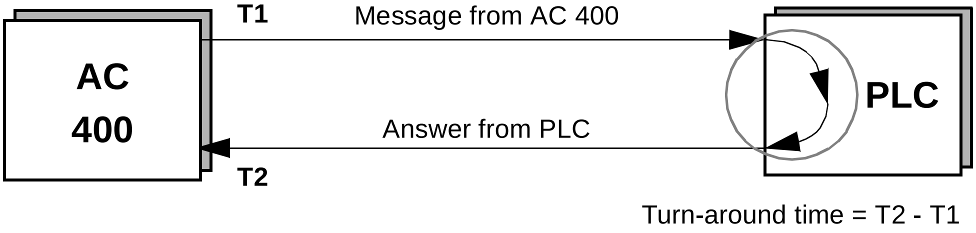


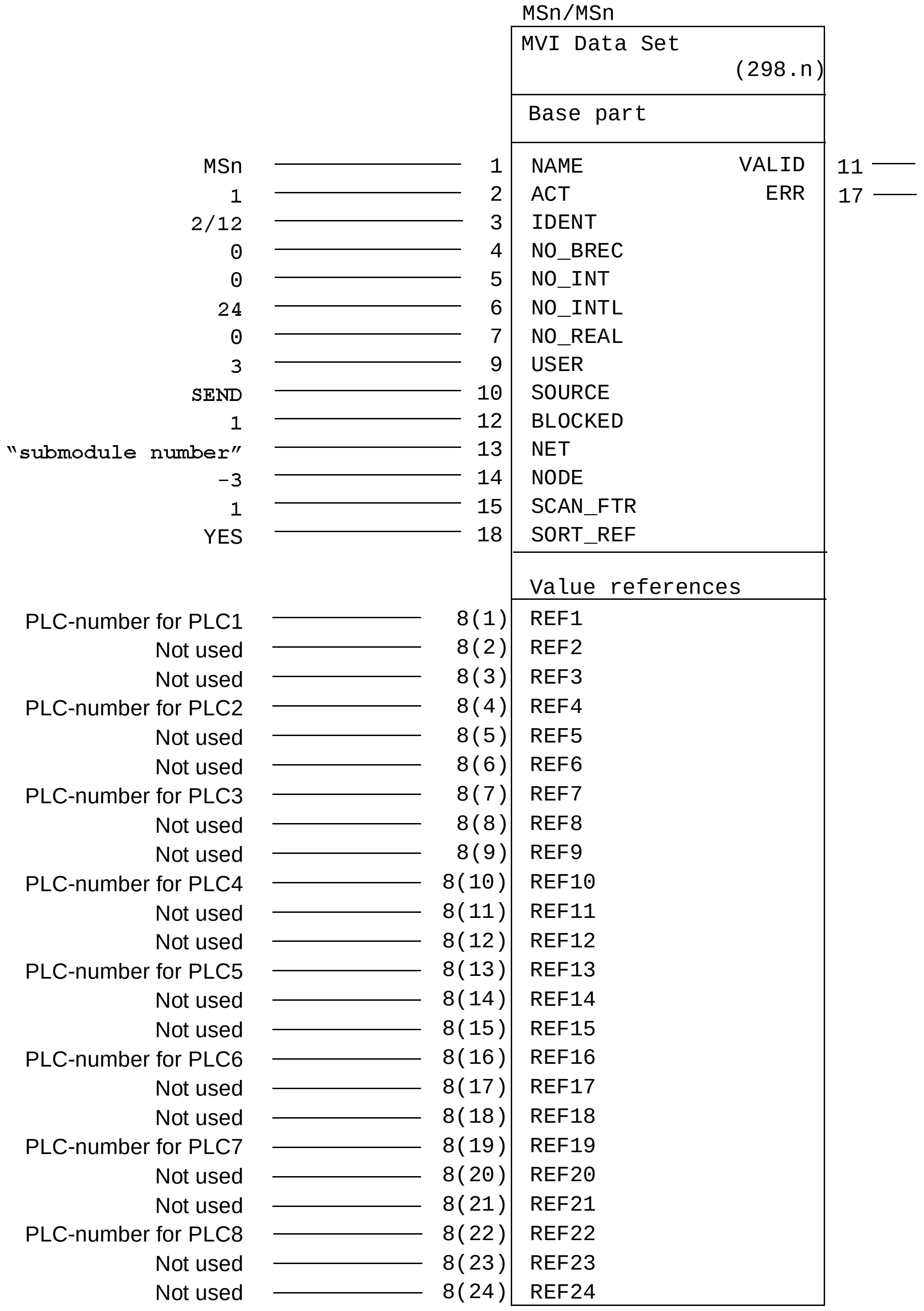
Figure 3-15. Turn-around Time

3.6.1.2 Network Configuration MS

The node numbers for the PLCs are defined in one MS for each communication port.
The Network Configuration MS is read by CI532V02 during its start-up/restart and when the Advant Controller 400 starts up. If CI532V02 works as a slave, only the master is described by the MS involved; this is done with REF1. **This MS must be blocked at runtime.**

NOTE

The CI532V02 submodule must always be restarted (see Section 2.4, Start-up Procedures) if the references in the Network Configuration MS are changed. Sending the Line Characteristics MS to the CI532V02 submodule for new initiation of the port is **not** enough.



MSn/MSn

MVI Data Set (298.n)

Base part

Value	Terminal	Parameter
MSn	1	NAME
1	2	ACT
2/12	3	IDENT
0	4	NO_BREC
0	5	NO_INT
24	6	NO_INTL
0	7	NO_REAL
3	9	USER
SEND	10	SOURCE
1	12	BLOCKED
"submodule number"	13	NET
-3	14	NODE
1	15	SCAN_FTR
YES	18	SORT_REF

Output	Terminal
VALID	11
ERR	17

Value references

Value	Terminal	Parameter
PLC-number for PLC1	8(1)	REF1
Not used	8(2)	REF2
Not used	8(3)	REF3
PLC-number for PLC2	8(4)	REF4
Not used	8(5)	REF5
Not used	8(6)	REF6
PLC-number for PLC3	8(7)	REF7
Not used	8(8)	REF8
Not used	8(9)	REF9
PLC-number for PLC4	8(10)	REF10
Not used	8(11)	REF11
Not used	8(12)	REF12
PLC-number for PLC5	8(13)	REF13
Not used	8(14)	REF14
Not used	8(15)	REF15
PLC-number for PLC6	8(16)	REF16
Not used	8(17)	REF17
Not used	8(18)	REF18
PLC-number for PLC7	8(19)	REF19
Not used	8(20)	REF20
Not used	8(21)	REF21
PLC-number for PLC8	8(22)	REF22
Not used	8(23)	REF23
Not used	8(24)	REF24

Figure 3-16. Example of MVI Data Set for Network Configuration

The parameters REF1 - REF24 are stored in DAT elements referenced by the Network Configuration MS. You can give the DAT elements arbitrary names.

Each PLC requires three DATs: the first DAT is used to define the node number and the other two are not used for MODBUS links.

Table 3-8. Description of MS for Network Configuration

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT		2 or 12	Identity of the MVI Data Set 2 for port 1 12 for port 2
NO_BREC		0	
NO_INT		0	
NO_INTL		24	Each defined PLC requires 3 Integer Long DATs. Always defined with 24 INTL DATs. The DATs not used must be zero.
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note:** The MS must be blocked. MS requested by the CI532V02 module at startup.
NET		7 - 11	CI532V02 submodule number. Record number for the CI532 data base element for the MVI-MODBUS port defines the submodule number. Record no 1 => submodule = 7 Record no 2 => submodule = 8 Record no 3 => submodule = 9 (only valid for AC 450) Record no 4 => submodule = 10 (only valid for AC 450) Record no 5 => submodule = 11 (only valid for AC 450)
NODE		-3	Always -3 for Configuration MS
SCAN_FTR		1	Without function when BLOCKED=1
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID			1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02 slave.

Table 3-8. Description of MS for Network Configuration (Continued)

Terminal	Parameter Name	Recommended Value	Description
	PLC number:	1-99	Node number of:
REF1	PLC1		PLC1
REF4	PLC2		PLC2
REF7	PLC3		PLC3
REF10	PLC4		PLC4
REF13	PLC5		PLC5
REF16	PLC6		PLC6
REF19	PLC7		PLC7
REF22	PLC8		PLC8
			Note: All the defined node numbers must be unique within the connected controller.
REF2 - 3 REF5 -6 REF8 - 9 REF11 - 12 REF14 - 15 REF17 - 18 REF20 - 21 REF23 24	Not used	0	Not used for MODBUS.

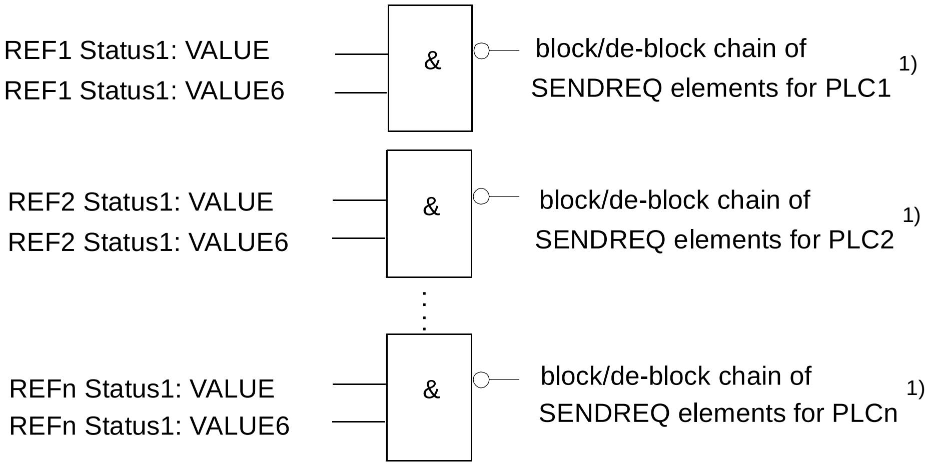
3.6.1.3 PLC Status MS

The status of every PLC is stored in an MS for each port. The status word is updated by CI532V02 and **may only be read by the PC program.**

Use the status information for flow control and error indication to application programs. The flow control is maintained through connecting bit0 (Link status) and bit5 (Ready for Message) in Status1, inverted, to the BLOCK input of all SENDREQ PC elements working against the same PLC (see Figure 3-17).

If necessary, you can also use further status for the blocking/de-blocking of the SENDREQ PC elements. See Section 3.6.1, MS for MVI-MODBUS Configuration.

The PLC Status MS is updated on every status change and at least every five seconds. This makes it possible for you to use this MS as a watchdog function for the CI532V02 submodule, using a time-out supervision on the PLC Status MS “VALID” flag.


REF1 Status1: VALUE
REF1 Status1: VALUE6
&
block/de-block chain of SENDREQ elements for PLC1
1)
REF2 Status1: VALUE
REF2 Status1: VALUE6
&
block/de-block chain of SENDREQ elements for PLC2
1)
REFn Status1: VALUE
REFn Status1: VALUE6
&
block/de-block chain of SENDREQ elements for PLCn
1)

1) For a description of the chain of SENDREQ PC elements, see Section 3.6.4.1, Type Circuits for MVI-MODBUS Data Flow Control

Figure 3-17. Status Handling for Flow Control

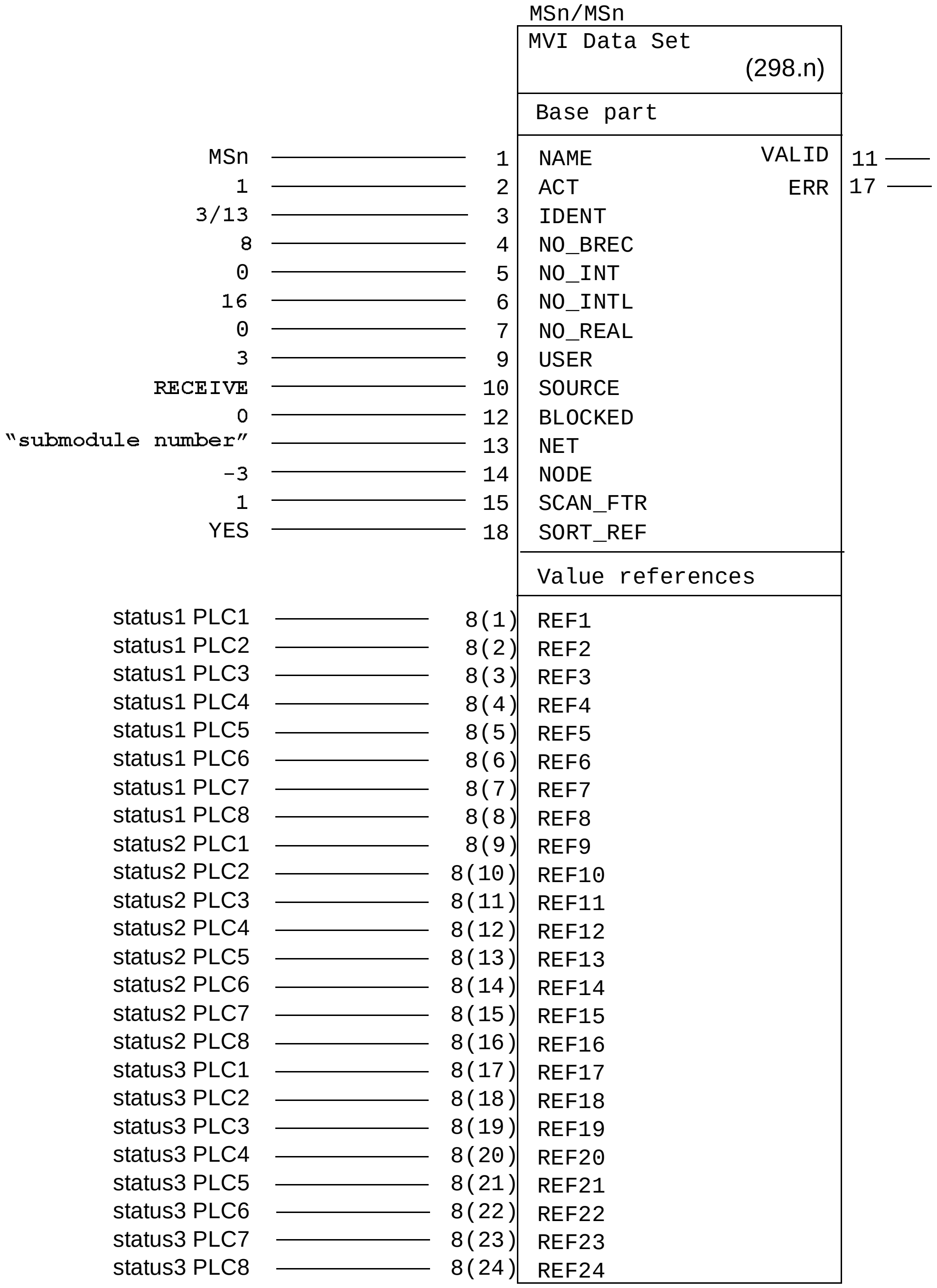


Figure 3-18. MVI Data Set for PLC Status

The parameters REF1 - REF24 are stored in DAT elements referenced from this Status MS. You can give the DAT elements arbitrary names.

Table 3-9. Description of MS for PLC Status

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set.
ACT		1	1 = Active, 0 = Inactive
IDENT		3 or 13	Identity of the MVI Data Set 3 for port 1 13 for port 2.
NO_BREC		8	Number of Boolean DAT references.
NO_INT		0	
NO_INTL		16	Number of Integer Long DAT references.
NO_REAL		0	
USER		3	
SOURCE		RECEIVE	
BLOCKED		0	The MS must always be de-blocked.
NET		7 - 11	CI532V02 submodule number. Record number for the CI532 data base element for the MVI-MODBUS port defines the submodule number. Record no 1 => submodule = 7 Record no 2 => submodule = 8 Record no 3 => submodule = 9 (only valid for AC 450) Record no 4 => submodule = 10 (only valid for AC 450) Record no 5 => submodule = 11(only valid for AC 450)
NODE		-3	Always -3 for Configuration MS.
SCAN_FTR		1	Used for reset of the VALID flag. VALID is set to 0 when the Time = 3*SCAN_FTR * MS_SCANTIME has passed. Default value for MS_SCANTIME = 2 s.
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID			1 when the MS is updated. See also SCAN_FTR above.
ERR			1 if wrong data size is received.

Table 3-9. Description of MS for PLC Status (Continued)

Terminal	Parameter Name	Recommended Value	Description
REF1	Status1 PLC1		First status word for PLC1
REF2	Status1 PLC2		First status word for PLC2
REF3	Status1 PLC3		First status word for PLC3
REF4	Status1 PLC4		First status word for PLC4
REF5	Status1 PLC5		First status word for PLC5
REF6	Status1 PLC6		First status word for PLC6
REF7	Status1 PLC7		First status word for PLC7
REF8	Status1 PLC8		First status word for PLC8
REF9	Status2 PLC1		Second status word for PLC2
REF10	Status2 PLC2		Second status word for PLC2
REF11	Status2 PLC3		Second status word for PLC3
REF12	Status2 PLC4		Second status word for PLC4
REF13	Status2 PLC5		Second status word for PLC5
REF14	Status2 PLC6		Second status word for PLC6
REF15	Status2 PLC7		Second status word for PLC7
REF16	Status2 PLC8		Second status word for PLC8
REF17	Status3 PLC1		Third status word for PLC1
REF18	Status3 PLC2		Third status word for PLC2
REF19	Status3 PLC3		Third status word for PLC3
REF20	Status3 PLC4		Third status word for PLC4
REF21	Status3 PLC5		Third status word for PLC5
REF22	Status3 PLC6		Third status word for PLC6
REF23	Status3 PLC7		Third status word for PLC7
REF24	Status3 PLC8		Third status word for PLC8

NOTE

You **must** build this MS with 24 DATs, according to the description above.

Status1 PLC1 - PLC8 (Boolean)

Contains information required for flow control, among other things, see Table 3-10, below.

Table 3-10. Status1 PLC1 - PLC8 (Boolean)

Status1	Description	Valid Modes
VALUE (bit0)	**Link status** The corresponding PLC reachable, see Figure 3-17. Set to "1" when the remote node is reachable. Set to "0" when contact with remote node is lost (including restart of CI532V02). The master considers the contact lost after maximum number of retransmissions of a signal without an answer. The slave node considers the contact lost when the times between messages from the master exceed the poll cycle time.	Master
VALUE2 (bit1)	Not used	
VALUE3 (bit2)	Not used	
VALUE4 (bit3)	**Illegal MS number received** Set to "1" when illegal MS number is received from an AMPL application command. Set to "0" when receiving a valid command MS.	Master
VALUE5 (bit4)	**Illegal Function code received** Set to "1" when illegal Function code is received from an AMPL application command. Set to "0" when receiving a valid command MS	Master
VALUE6 (bit5)	**Ready for Message** Set to "1" when no command is pending, from the application to the PLC. Set to "0" when a command is pending, from the application to the PLC. Used by the PC program for flow control, see Figure 3-17.	Master
VALUE7 (bit6)	**Illegal Function code reported from PLC** (MODBUS Exception Response Code 1). The Function code can not be handled by the PLC. Set to "1" when received. Set to "0" when CI532V02 is restarted.	Master
VALUE8 (bit7)	**Illegal data address reported from PLC** (MODBUS Exception Response Code 2.) The address referenced in the data field is not an allowed address in the slave. Set to "1" when Response Code 2 is received. Set to "0" when CI532V02 is restarted.	Master
VALUE9 (bit8)	**Illegal data value reported from PLC** (MODBUS Exception Response Code 3). The value referenced in the data field is not allowed in the slave. Set to "1" when Response Code 3 is received. Set to "0" when CI532V02 is restarted.	Master

Table 3-10. Status1 PLC1 - PLC8 (Boolean) (Continued)

Status1	Description	Valid Modes
VALUE10 (bit9)	**Failure in associated device reported from PLC** (MODBUS Exception Response Code 4). Set to “1” when Response Code 4 is received. Set to “0” when CI532V02 is restarted.	Master
VALUE11 (bit10)	**Memory parity error reported from PLC** (MODBUS Exception Response Code 8). Set to “1” when Response Code 8 is received. Set to “0” when CI532V02 is restarted.	Master
VALUE12 (bit11) to VALUE16 (bit15)	Not used	Not used
VALUE17 (bit16)	**Response data from Function code 7 (Exception status). Bit 0** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE18 (bit17)	**Response data from Function code 7 (Exception status). Bit 1** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE19 (bit18)	**Response data from Function code 7 (Exception status). Bit 2** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE20 (bit19)	**Response data from Function code 7 (Exception status). Bit 3** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE21 (bit20)	**Response data from Function code 7 (Exception status). Bit 4** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE22 (bit21)	**Response data from Function code 7 (Exception status). Bit 5** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE23 (bit22)	**Response data from Function code 7 (Exception status). Bit 6** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE24 (bit23)	**Response data from Function code 7 (Exception status). Bit 7** Set to “0” at restart of CI532V02.	Master (See **NOTE** below.)
VALUE25 (bit24) to VALUE32 (bit31)	Not used	Not used

NOTE

Status 1 VALUE17 - 24 describe the response from the Function code 7, Read Exception status. The response is hardware specific.
For further information, refer to *Gould MODBUS Protocol Reference Guide PI-MBUS-300 Rev. D, see Section 1.8.1, Functionality.*

Status2 PLC1 - PLC8 (Integer Long)

If Status1 VALUE4 = 1 or VALUE8 = 1, i.e., an address error, the Status2 holds the address that caused the error. Status2 is reset at restart of the CI532V02.

Status3 PLC1 - PLC8 (Integer Long)

If Status1 VALUE5 = 1 or VALUE7 = 1, that is, an illegal Function code, the Status3 holds the Function code that caused the error. Status3 is reset at restart of the CI532V02.

3.6.1.4 Register Addresses MS

A translation between the Advant Controller 400 MS identities and the MODBUS Register Addresses must be made, since the addressing of registers differs between Advant OCS and the MODBUS protocol.

For this purpose, a cross-reference table is used on the CI532V02 submodule. This table is defined by a number of Register Addresses MS that must be built. These Register Addresses MS must contain the MODBUS Register Addresses.

Each DAT reference in the Register Addresses MS corresponds to a Data MS. The DAT elements connected to the Register Addresses MS hold a MODBUS register address corresponding to the start of the data (first DAT) in the corresponding Data MS. See Section 3.6.3, Data MS for Data Transfer. (Only the Data MS used for data exchange must be built.)

The same start Register Addresses apply to both **sending** Data MS (IDENT = 1-96) and **receiving** Data MS (IDENT = 101-196). See also Figure 3-19.

NOTE

> In order to update only a part of an MS, there must always be a sending MS (IDENT = 1-96) corresponding to a receiving MS (IDENT = 101-196).
> The sending and receiving Data MS are connected to the same DAT elements. When the CI532V02 submodule receives data from the PLC, the sending Data MS is requested from Advant Controller 400. The received data from the PLC is mapped into the data from the sending Data MS before it is sent back to the receiving Data MS in the Advant Controller 400.

The First Register Addresses MS (IDENT = 4 for port 1 and 14 for port 2) holds the MODBUS start register address for:

- Data MS with IDENT = 1 and 101 in REF1
- Data MS with IDENT = 2 and 102 in REF2

.

.

- Data MS with IDENT = 24 and 124 in REF24

The Second Register Addresses MS (IDENT = 5 for port 1 and 15 for port 2) holds the MODBUS start register address for:

- Data MS with IDENT = 25 and 125 in REF1
- Data MS with IDENT = 26 and 126 in REF2

.

.

- Data MS with IDENT = 48 and 148 in REF24

The Third Register Addresses MS (IDENT = 6 for port 1 and 16 for port 2) holds the MODBUS start register address for:

- Data MS with IDENT = 1 and 101 in REF1
- Data MS with IDENT = 2 and 102 in REF2

  .

  .

- Data MS with IDENT = 72 and 172 in REF24

The Fourth Register Addresses MS (IDENT = 7 for port 1 and 17 for port 2) holds the MODBUS start register address for:

- Data MS with IDENT = 73 and 173 in REF1
- Data MS with IDENT = 74 and 174 in REF2

  .

  .

- Data MS with IDENT = 96 and 196 in REF24

The DAT elements in the **Data MS** must be connected as follows:

- Data MS with IDENT = 1 is connected to the same DAT element as the Data MS with IDENT = 101.
- Data MS with IDENT = 2 is connected to the same DAT element as the Data MS with IDENT = 102.
- Data MS with IDENT = 3 is connected to ..... and so on.

The same register address must **not** exist in two different Data MS to the same PLC. These Register Address MS must **always be blocked**. They are automatically downloaded to the CI532V02 submodule at start-up/restart.

NOTE

If the start addresses for the MVI Data Sets are changed, the submodule must be restarted to re-initialize the cross-reference table. If, on the other hand, the size of a Data MS is changed within the allowed limits, no restart is necessary. See Section 3.6.3, Data MS for Data Transfer.

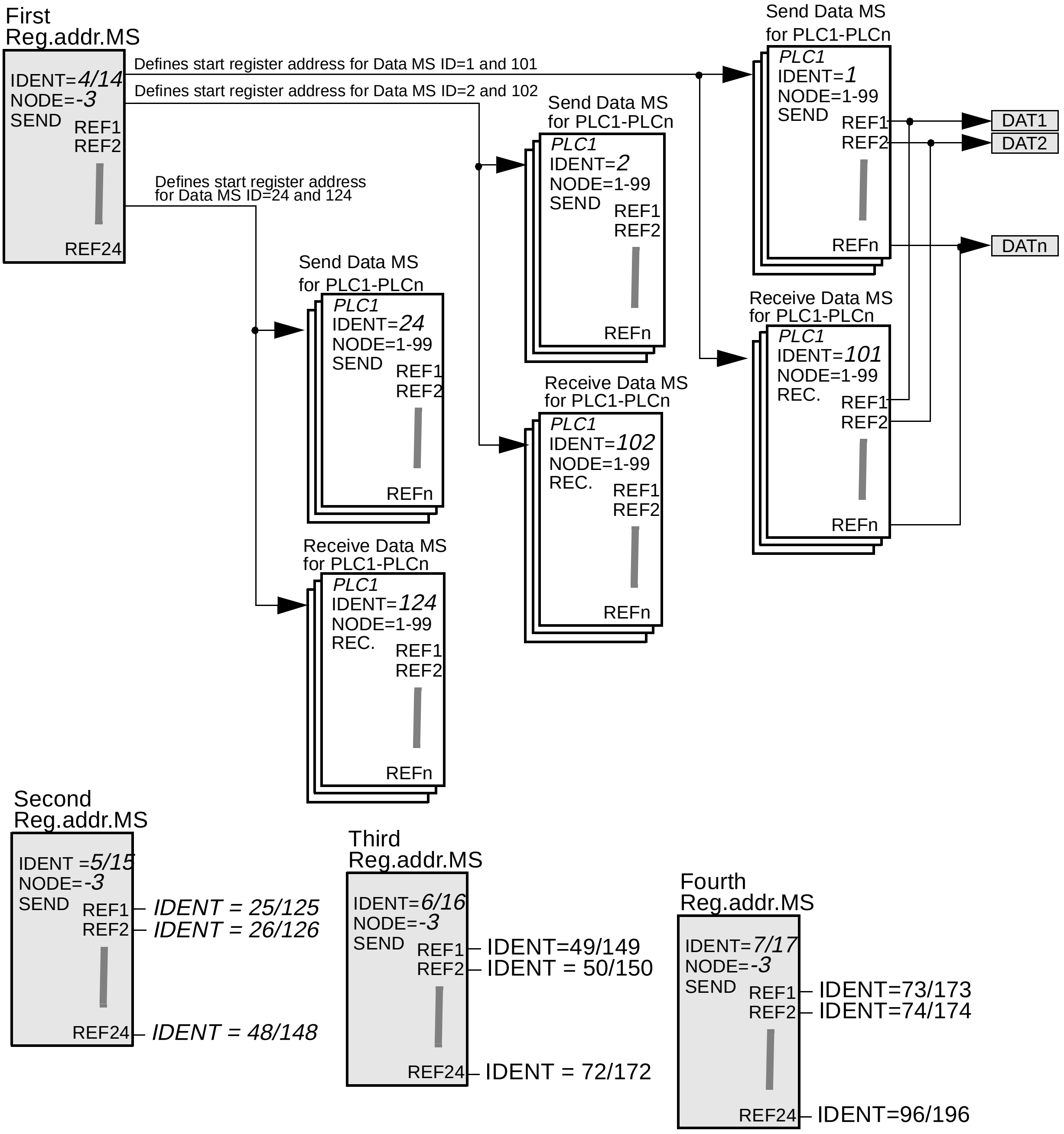


Figure 3-19. Register Addresses MS - Data MS Relationship

Each of the Register Addresses MS must be built with 24 DATs. The start addresses for the Data MS must be written consecutively to the Register Addresses MS. This means that no holes are permitted in the Register Addresses MS. End of Data MS is marked by writing zero ('0') into the first unused DAT of the Register Addresses MS, see Section 3.6.1.4, Register Addresses MS.

The number of Register Addresses MS to be built is between one and four, depending on how many Data MS will be used.

When Boolean registers are used in the Data MS, each DAT(B) contains the equivalent of 32 MODBUS Boolean registers. Every Integer DAT(I) element corresponds to one MODBUS Integer register.

Example

- If MS IDENT = 1 (or IDENT = 101) is set at 0001 in the Register Addresses MS, and MS with IDENT = 1 (or IDENT = 101) is configured for 20 DATs, it will contain:

  20 DAT(B) * 32 = 640 Boolean registers.

  Where VALUE in the first DAT(B) corresponds to register address 0001, and VALUE2 corresponds to register address 0002, VALUE32 in the last DAT(B) will correspond to register address 0640. In this case, MS IDENT = 2 (or IDENT = 102) must be set at 0641 or higher in the Register Addresses MS (if that data MS is used) to avoid overlapping.

- If MS IDENT = 17 (or IDENT = 117) is set at 3001 in the Register Addresses MS, and the former is configured for 20 DATs, it will contain:

  20 DAT(I) Integer (2 bytes) registers.

  Then, MS IDENT = 18 (or IDENT = 118) must be set at 3021 or higher in the Register Addresses MS (if that data MS is used) to avoid overlapping.

The table below shows allowed MODBUS register values for different Function codes and address models:

Table 3-11. Allowed MODBUS Register Values

Function Code	Small Address Model	Large Address Model
1: Read output status 5: Force single coil 15: Force multiple coils	0001 - 0999	00001 - 09999
2: Read input status	1001 - 1999	10001 - 19999
4: Read input register	3001 - 3999	30001 - 39999
3 Read output register 6: Preset single register 16: Preset multiple registers	4001 - 4999	40001 - 49999

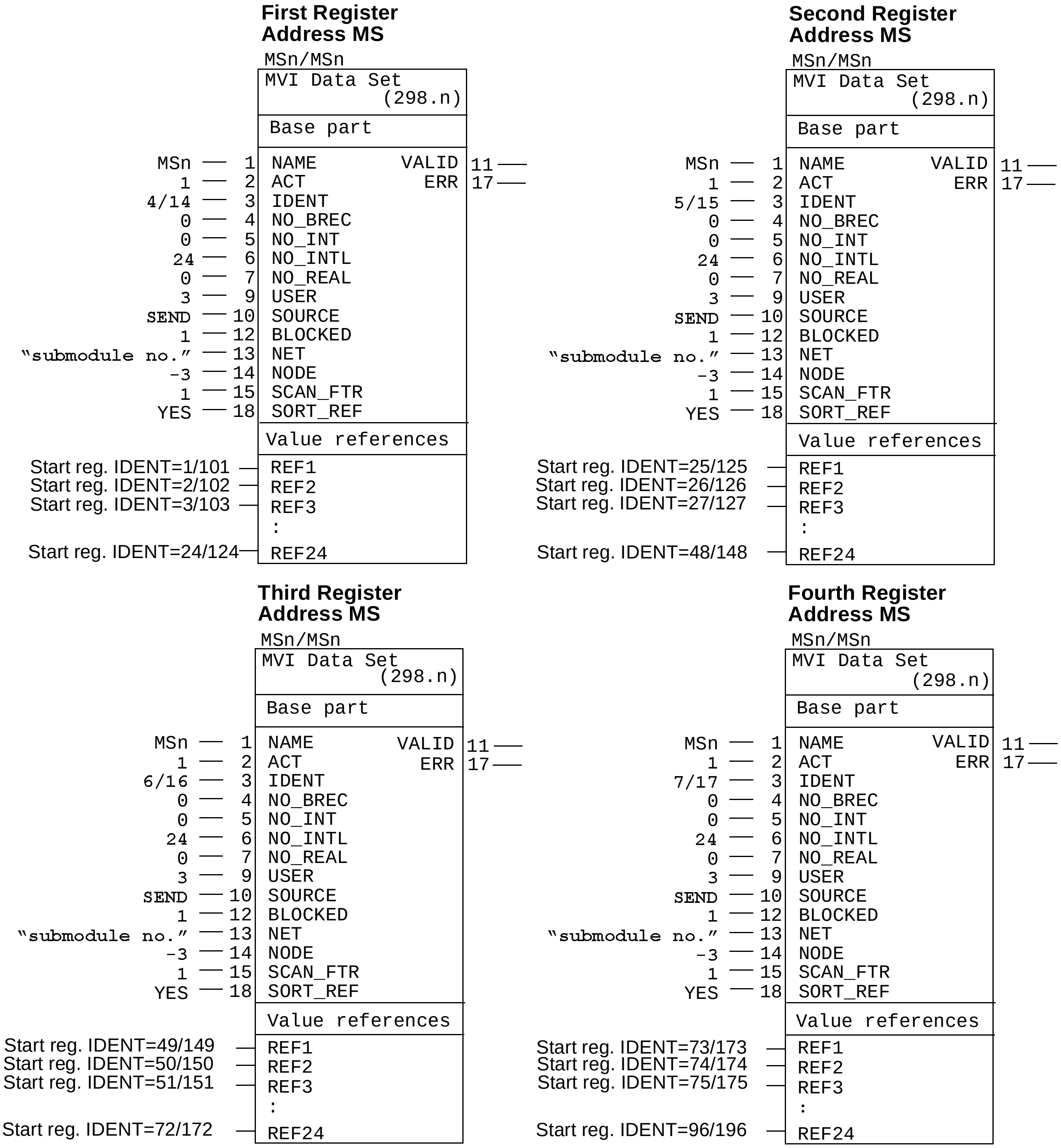


Figure 3-20. MVI Data Sets for Register Addresses

The parameters REF1 - REF24 are stored in DAT elements referred to by this MVI Data Set. You can give the DAT elements arbitrary names.

Table 3-12. Description of Register Addresses MS

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT		Port 1: 4 - 7 Port 2: 14 - 17	Identity of the MVI Data Set -First Register Address MS: Port 1: IDENT = 4 Port 2: IDENT = 14 -Second Register Address MS: Port 1: IDENT = 5 Port 2: IDENT = 15 -Third Register Address MS: Port 1: IDENT =6 Port 2: IDENT = 16 -Fourth Register Address MS: Port 1: IDENT = 7 Port 2: IDENT = 17
NO_BREC		0	
NO_INT		0	
NO_INTL		24	Number of Integer Long DAT references
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		0	**Note:** The MS must be blocked. MS requested by the CI532V02 module at start-up.
NET		7 - 11	CI532V02 submodule number. Record number for the CI532 data base element for the MVI-MODBUS port defines the submodule number. Record no 1 => submodule = 7 Record no 2 => submodule = 8 Record no 3 => submodule = 9 (only valid for AC 450) Record no 4 => submodule = 10 (only valid for AC 450) Record no 5 => submodule = 11 (only valid for AC 450)

Table 3-12. Description of Register Addresses MS (Continued)

Terminal	Parameter Name	Recommended Value	Description
NODE		-3	
SCAN_FTR		1	Without function when BLOCKED=1.
VALID		1	1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.
REF1 - REF24		Small address model: 0001 - 0999 1001 - 1999 3001 - 3999 4001 - 4999 Large address model: 00001 - 09999 10001 - 19999 30001 - 39999 40001 - 49999	Start register address for corresponding to: Sending Data MS with IDENT =1 - 96 and Receiving Data MS with IDENT = 101 - 196. See Table 3-13 for relation between REF in Register Address MS and IDENT for Data MS.

Table 3-13. Relation between REF in Register Address MS and IDENT for Data MS

DAT Reference in Register Addresses MS	**Data MS IDENT in First Register Addresses MS (Send/Receive)**	**Data MS IDENT in Second Register Addresses MS (Send/Receive)**	**Data MS IDENT in Third Register Addresses MS (Send/Receive)**	**Data MS IDENT in Fourth Register Addresses MS (Send/Receive)**
REF1	1/101	25/125	49/149	73/173
REF2	2/102	26/126	50/150	74/174
REF3	3/103	27/127	51/151	75/175
REF4	4/104	28/128	52/152	76/176
REF5	5/105	29/129	53/153	77/177
REF6	6/106	30130	54/154	78/178
REF7	7/107	31/131	55/155	79/179
REF8	8/108	32/132	56/156	80/180
REF9	9/109	33/133	57/157	81/181
REF10	10/110	34/134	58/158	82/182
REF11	11/111	35/135	59/159	83/183
REF12	12/112	36/136	60/160	84/184
REF13	13/113	37/137	61/161	85/185
REF14	14/114	38/138	62/162	86/186
REF15	15/115	39/139	63/163	87/187
REF16	16/116	40/140	64/164	88/188
REF17	17/117	41/141	65/165	89/189
REF18	18/118	42/142	66/166	90/190
REF19	19/119	43/143	67/167	91/191
REF20	20/120	44/144	68/168	92/192
REF21	21/121	45/145	69/169	93/193
REF22	22/122	46/146	70/170	94/194
REF23	23/123	47/147	71/171	95/195
REF24	24/124	48/148	72/172	96/196

Example of Register Addresses

The minimum number of Register Addresses MS depends on the number of Data MS to be used.

Table 3-14. Minimum Number of Register Address MS

Number of Data MS	Number of Register Addresses MS
1 - 23	1
24 - 47	2
48 - 71	3
72 - 96	4

This example describes a configuration that uses 14 Data MS. The first Register Address MS (IDENT = 4 or 14) could have the following configuration:

Table 3-15. Example of Register Addresses

DAT Reference in First Register Addresses MS	DAT Value	Data MS IDENT (Send/Receive)
REF1	1	1/101
REF2	641	2/102
REF3	10001	3/103
REF4	10769	4/104
REF5	30001	5/105
REF6	929	6/106
REF7	40001	7/107
REF8	40025	8/108
REF9	40100	9/109
REF10	40050	10/110
REF11	40150	11/111
REF12	40200	12/112
REF13	40250	13/113
REF14	11000	14/114
REF15	0 (See **Note** below.)	15/115

Table 3-15. Example of Register Addresses (Continued)

DAT Reference in First Register Addresses MS	DAT Value	Data MS IDENT (Send/Receive)
REF16	0	16/116
REF17	0	17/117
REF18	0	18/118
REF19	0	19/119
REF20	0	20/120
REF21	0	21/121
REF22	0	22/122
REF23	0	23/123
REF24	0	24/124

NOTE

The DAT value for the last reference in the Register Address MS must always end with zero ("0") (except when all 96 Data MS are used).

The other three Register Addresses MS (IDENT = 5, 6, 7 or 15, 16, 17) do not have to be built in this example.

The MODBUS Register Addresses do not have to be in order in the register address MS.

No holes in the register address MS are permitted. For example:

~~REF1 (MS with IDENT = 1/102) = 1~~
~~REF2 (MS with IDENT = 2/102) = 0~~
~~REF3 (MS with IDENT = 3/103) = 10001~~

This configuration is not permitted. The data MS (IDENT = 3/103) with start address 10001 will not be accessible in this example.

3.6.2 Command MS used in Master Mode

This section describes the Command MS used for control of the data transfer in master mode. The Command MS are only defined and used if the CI532V02 submodule is used as a master on the MODBUS link. All Command MS used must be included in the send sequence according to Section 3.6.4.1, Type Circuits for MVI-MODBUS Data Flow Control.

These Command MS are used by the application program to activate Read and Write Commands from CI532V02 to the corresponding PLC slave.

3.6.2.1 Read Command

To update a value in Advant Controller 400, a Read Command must be issued to the corresponding slave unit. A number of Read Command MS are used for this purpose (IDENT = 201, 202, 203 and 204), corresponding to MODBUS Function codes 1, 2, 3 and 4.

The Command MS contain two DATs:

- The first DAT contains the start register address to read.
- The second DAT contains the number of registers (values) to read.

The data returned by the PLC is received by a receiving Data MS with the corresponding register address and IDENT = 101-196 according to the Register Address MS with IDENT = 4, 5, 6, 7 (port 1) or 14, 15, 16, 17 (port 2).

No Read Command MS are created when CI532V02 operates as a slave on the MODBUS link, since all data transfer is handled with commands from the master only.

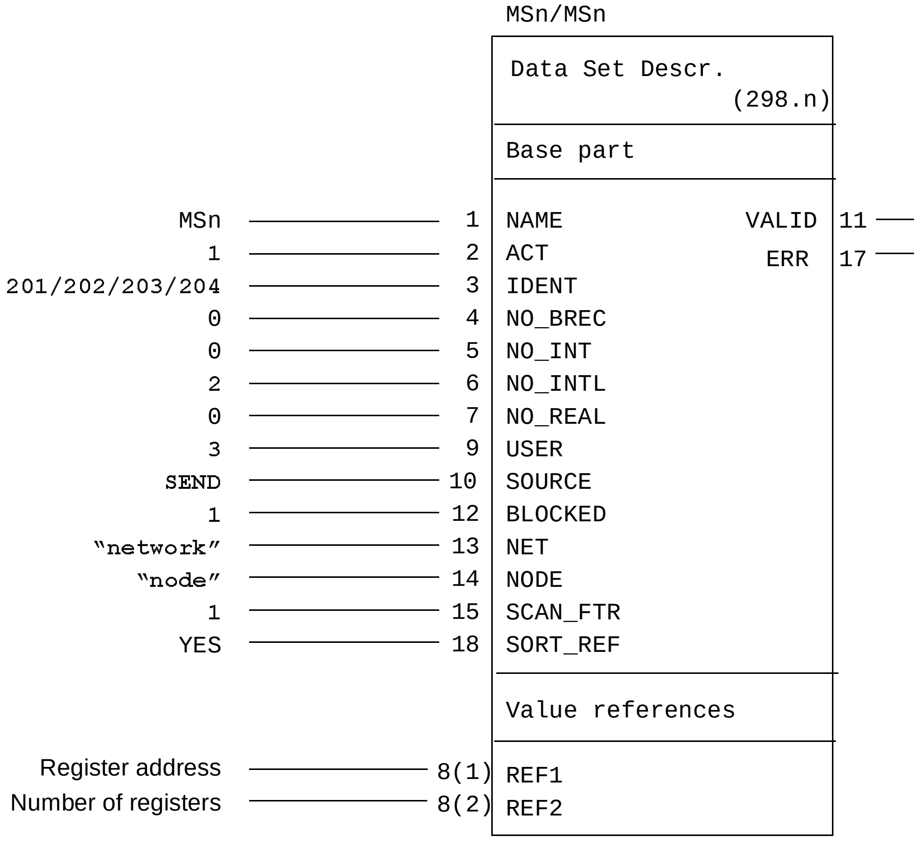


Figure 3-21. Read Command MS

The parameters REF1 - REF2 are stored in DAT elements referred to by this MVI Data Set. You can give the DAT elements arbitrary names.

Table 3-16. Description of MS for Read Command

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT			The identity of the MVI Data Set 201 = (Func 1) read output status 202 = (Func 2) read input status 203 = (Func 3) read output register 204 = (Func 4) read input register
NO_BREC		0	
NO_INT		0	
NO_INTL			Number of Integer Long DAT references
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note**: The MS must be blocked.
NET		1 - 9	Network number of the MVI-MODBUS bus. Defined in the CI532 data base element for the CI532V02 submodule. See Chapter 2, Installation.
NODE		1 - 99	PLC number (node) of the receiving PLC. Valid node numbers must be defined in the Network Configuration MS. **Note:** All the defined node numbers must be unique within the connected controller.
SCAN_FTR		1	Without function when BLOCKED=1.
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID		1	1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.

Table 3-16. Description of MS for Read Command (Continued)

Terminal	Parameter Name	Recommended Value	Description
REF 1	Register address	Small address model: 0001 - 0999 1001 - 1999 3001 - 3999 4001 - 4999 Large address model: 00001 - 09999 10001 - 19999 30001 - 39999 40001 - 49999	The first register address to be read. This register address must be found in an MS defined in one of the Register Addresses MS, with IDENT = 4, 5, 6, 7 (port 1) or 14, 15,16, 17 (port 2). The address is written by the PC program before the MS is sent.
REF2	Number of registers		The number of registers to be read. The PC program enters the number of registers before the Command MS is sent.
		Function code 1 and 2: 1 - 2000	Function code 1 and 2: Max number of registers = 2000. 768 registers can be stored in one Data MS.
		Function code 3 and 4: 1 - 125	Function code 3 and 4: Max number of registers = 125 24 registers can be stored in one Data MS.

3.6.2.2 Write Command

To update a value in a slave, a Write Command must be issued to the corresponding slave unit. A number of Command MS are used for this purpose (IDENT = 205, 206, 215 and 216), corresponding to MODBUS Function codes 5, 6, 15 and 16.

The Write Command MS contain two DATs:

- The first DAT contains the start register address to write.
- The second DAT contains the number of registers (values) to write (not used for IDENT = 205 and 206).

The data to be sent is fetched by CI532V02 from a sending Data MS (IDENT = 1-96) registers according to the definition entered into the Register Address MS with IDENT = 4, 5, 6, 7 (port 1) or 14, 15, 16, 17 (port 2).

No Write Command MS are created when CI532V02 operates as a slave on the MODBUS link, since all data transfer is handled with commands from the master only.

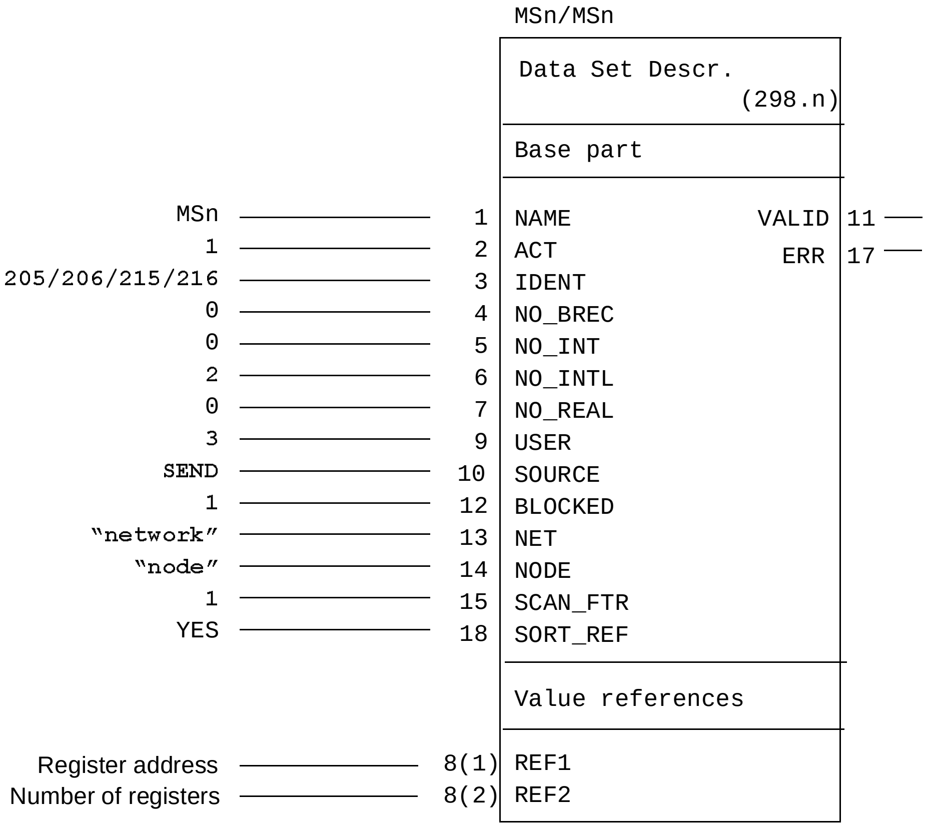


Figure 3-22. Write Command MS

The parameters REF1 - REF2 are stored in DAT elements referred to by this MVI Data Set. The DAT elements can be given arbitrary names.

Table 3-17. Description of MS for Write Command

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT			The identity of the MVI Data Set 205 = (Func 5) force single coil 206 = (Func 6) preset single register 215 = (Func 15) force multiple coil 216 = (Func 16) preset multiple register
NO_BREC		0	
NO_INT		0	

Table 3-17. Description of MS for Write Command (Continued)

Terminal	Parameter Name	Recommended Value	Description
NO_INTL		2	Number of Integer Long DAT references
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note:** The MS must be blocked.
NET		1 - 9	Network number of the MVI-MODBUS channel. Defined in the CI532 data base element for the CI532V02 submodule. See Chapter 2, Installation.
NODE		1 - 99	PLC number (node) of the receiving PLC. Valid node numbers must be defined in the Network Configuration MS. **Note:** All the defined node numbers must be unique within the connected controller.
SCAN_FTR		1	Without function when BLOCKED=1
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID		1	1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.
REF 1	Register address	Small address model: 0001 - 0999 1001 - 1999 3001 - 3999 4001 - 4999 Large address model: 00001 - 09999 10001 - 19999 30001 - 39999 40001 - 49999	The first register address to be written. This register address must be found in an MS defined in one of the Register Addresses MS, with IDENT = 4, 5, 6, 7 (port 1) or 14, 15,16, 17 (port 2). The address is written by the PC program before the MS is sent.
REF2	Number of registers		The number of registers to be read. The PC program enters the number of registers before the Command MS is sent. Not used for Function codes 5 and 6.
		Function code 15: 1 - 2000	Function code 15: Max number of registers = 2000. 768 registers can be stored in one Data MS.
		Function code 16: 1 - 125	Function code 16: Max number of registers = 125 24 registers can be stored in one Data MS.

3.6.2.3 Requesting Slave Status

It is possible to request status information from a slave. This is maintained by a Read Status Command MS. This MS only contains one (1) DAT set to zero (0). The reply is received by the Status MS Status1 VALUE17 (bit16) -VALUE24 (bit23), see Section 3.6.1.3, PLC Status MS

No Read Status Command MS is created when CI532V02 operates as a slave on the MODBUS link, since all data transfer is handled with commands from the master only.

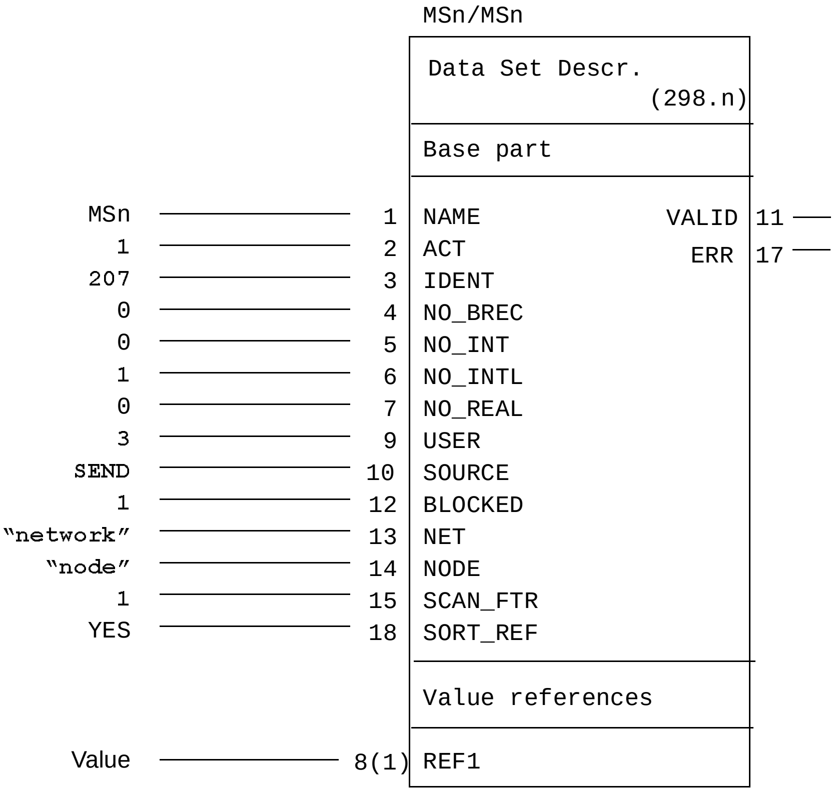


Figure 3-23. Status Request Command MS

The parameter REF1 is stored in DAT element referred to by this MVI Data Set. The DAT elements can be given arbitrary names.

Table 3-18. Description of MS for Status Request

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT			The identity of the MVI Data Set 207=(Func 7), read exception status
NO_BREC		0	
NO_INT		0	
NO_INTL		1	Number of Integer Long DAT references
NO_REAL		0	
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note:** The MS must be blocked.
NET		1 - 9	Network number of the MVI-MODBUS bus. Defined in the CI532 data base element for the CI532V02 submodule. See Chapter 2, Installation.
NODE		1 - 99	PLC number (node) of the receiving PLC. Valid node numbers must be defined in the Network Configuration MS. **Note:** All the defined node numbers must be unique within the connected controller.
SCAN_FTR		1	Without function when BLOCKED=1.
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID		1	1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.
REF 1	Value	0	Value = 0

3.6.3 Data MS for Data Transfer

3.6.3.1 Data Transmission to a PLC

MS for transmission of data to the PLC are defined in the same way as normal sending Data Set. The difference is that the MS used for data transmission on MODBUS must be blocked (BLOCKED = 1) and USER = 3.

Master Mode

The transmission of the MS is controlled by the Write Command MS (IDENT = 205, 206, 215 or 216) together with the CI532V02 submodule.

The transmission is controlled by a PC program (see Section 3.6.4, PC Program Layout) which sends a Write Command MS to the CI532V02 submodule Section 3.6.2.2, Write Command. The CI532V02 submodule requests the sending Data MS containing the addressed registers and transmits them to the addressed PLC.

Slave Mode

The transmission of the Data MS is controlled by a Read Command from the MODBUS master Function codes 1 - 4 together with the CI532V02 submodule.

The CI532V02 submodule will request for the sending Data MS containing the addressed registers and return the defined registers to the master.

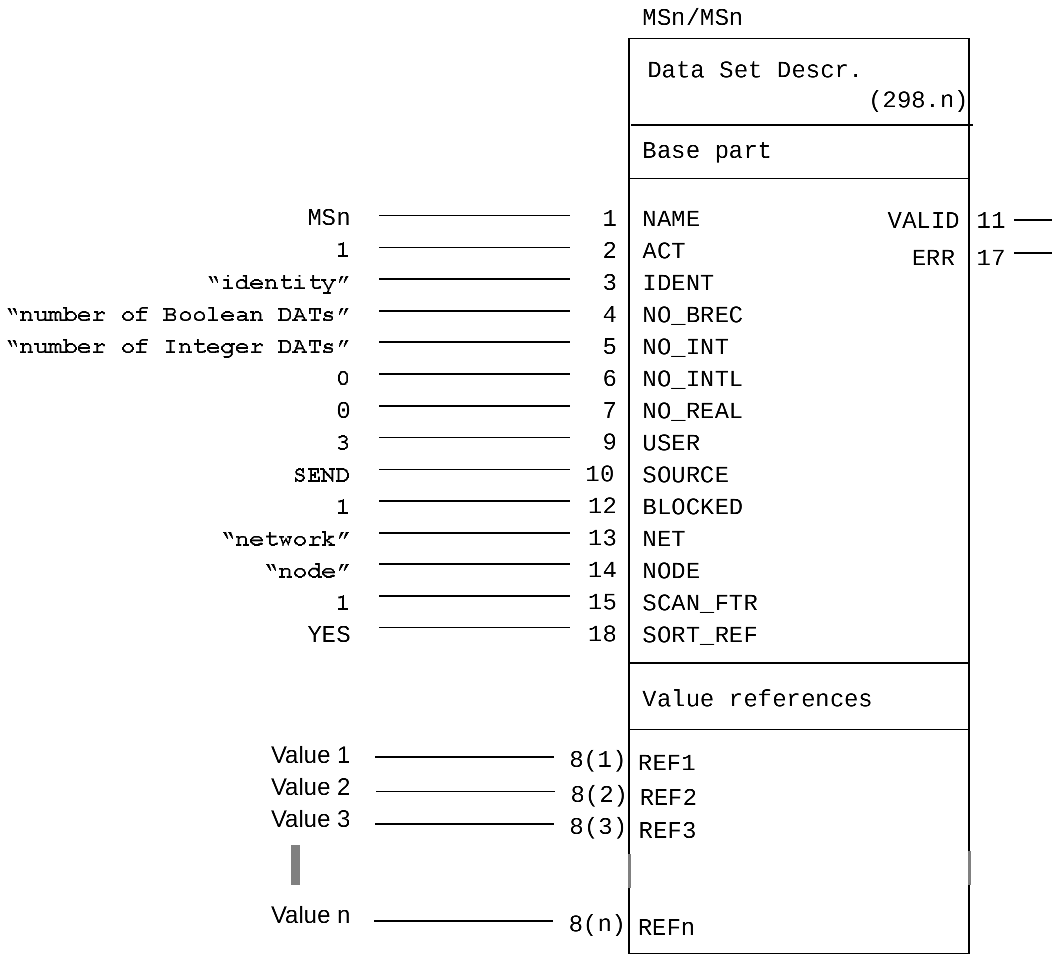


Figure 3-24. MVI Data Set for Transmission of Data

The parameters REF1 - REF24 are stored in DAT elements referred to by this MVI Data Set. You can give the DAT elements arbitrary names.

Table 3-19. Description of MS for Transmission of Data

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set
ACT		1	1 = Active, 0 = Inactive
IDENT			The Identity of the MVI Data Set (1-96)
NO_BREC		0 - 24	Only user for Function codes: 1, 2, 5, and 15 **Note:** Every DAT corresponds to 32 coils/status registers.
NO_INT		0 - 24	Only used for Function codes: 3, 4, 6 and16.
NO_INTL		0	0, not used
NO_REAL		0	0, not used
USER		3	
SOURCE		SEND	
BLOCKED		1	**Note:** The MS must be blocked.
NET		1 - 9	Network number of the MVI-MODBUS bus. Defined in the CI532 database element for the CI532V02 submodule. See Chapter 2, Installation.
NODE		1 - 99	PLC number (node) of the receiving PLC. Valid node number must be defined in the Line Characteristics MS. **Note:** All the defined node numbers must be unique within the connected controller.
SCAN_FTR		1	Without function when BLOCKED = 1.
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID		1	1 after first successful transmission. Reset by user.
ERR			1 if the transmission has failed due to lost contact with destination node or queue full to CI532V02.
REF 1	Value 1		DAT element to be sent to the PLC.
REF2	Value 2		DAT element to be sent to the PLC.
REF3	Value 3		DAT element to be sent to the PLC.
REFn	Value n		DAT element to be sent to the PLC.

3.6.3.2 Data Transmission from a PLC

MS for reception of data from PLCs are defined in the same way as normal receiving Data Sets (DS), except USER=3.

NOTE

> Every receiving Data MS must have a corresponding sending Data MS to make the DATs accessible for the communication handler on the CI532V02 submodule. These MS must have IDENT = (IDENT (of receiving MS) - 100). In order to allow updating of only a part of a Data MS, there must always be a sending Data MS (IDENT = 1-96) corresponding to a receiving Data MS (IDENT = 101-196). The sending and receiving Data MS are connected to the same DAT elements. When the CI532V02 submodule receives data from the PLC, the sending Data MS is requested from Advant Controller 400. The received data from the PLC is mapped into the data from the sending Data MS before it is sent back to the receiving Data MS in the Advant Controller 400.

Master Mode

The data is requested from the PLC with a Read Command MS (IDENT = 201, 202, 203 or 204) together with the CI532V02 submodule.

The transmission is controlled by a PC program (see Section 3.6.4, PC Program Layout) which sends a Read Command MS to the CI532V02 submodule, see Section 3.6.2.2, Write Command. The CI532V02 submodule requests the sending Data MS containing the addressed registers and transmits the corresponding Read Command to the addressed PLC.

The reply from the PLC is mapped into the previous requested Data MS and returned to the corresponding receiving Data MS.

Slave Mode

A Write Command (Function code 5, 6, 15 or 16) is received from the master containing data. The CI532V02 submodule requests the sending MS containing the addressed registers. The data from the master is mapped into the previously requested MS and returned to the corresponding receiving MS.

The parameters REF1 - REF24 are stored in DAT elements referred to by this MVI Data Set. The DAT elements can be given arbitrary names.

Table 3-20. Description of MS for Reception of Data

Terminal	Parameter Name	Recommended Value	Description
NAME			Unique NAME of the MVI Data Set.
ACT		1	1 = Active, 0 = Inactive
IDENT			Identity of the MVI Data Set (101-196).
NO_BREC		0 - 24	Only user for Function codes: 1, 2, 5, and 15 Note1: Every DAT corresponds to 32 coils/status registers.
NO_INT		0 - 24	Only used for Function codes: 3, 4, 6 and16.
NO_INTL		0	0, not used.
NO_REAL		0	0, not used.
USER		3	
SOURCE		RECEIVE	
BLOCKED		0	**Note:** The MS must be unblocked.
NET		1 - 9	Network number of the MVI-MODBUS bus. Defined in the CI532 data base element for the CI532V02 submodule. See Chapter 2, Installation.
NODE		1 - 99	PLC number (node) of the receiving PLC. Valid node numbers must be defined in the Network Configuration MS. **Note:** All the defined node numbers must be unique within the connected controller.
SCAN_FTR		1	Used for reset of the VALID flag. VALID is set to 0 when the Time = 3∗SCAN_FTR ∗ MS_SCANTIME (one second) has passed. Default value for MS_SCANTIME = 2 s.
SORT_REF		YES	REF1-24 sorted with Boolean DATs first, then Integer and long Integer and, finally, Real DATs.
VALID		1	1 when the MS is updated. See also SCAN_FTR above.
ERR			1 if wrong data size is received.
REF 1	Value1		DAT element from the PLC.
REF2	Value 2		DAT element from the PLC.
REFn	Value n		DAT element from the PLC.

3.6.3.3 Transfer of Appended Data MS

The MODBUS functions 1, 2, 3, 4, 15 and 16 (Command MS with IDENT = 201, 202, 203, 204, 215 and 216) support data transfer from more than one Data MS in the same MODBUS message, i.e., handling of more than 768 registers (coil/status) for Function code 1, and 15 and more than 24 registers for Function code 3, 4 and 16. If these MODBUS functions must request or transmit data from two or more Data MS, the following must be accomplished:

- The MODBUS Register Addresses must be consecutive in all Data MS used for one command (no holes are permitted). The last MODBUS register address for the first Data MS must be followed directly by the start register address for the second Data MS, the last MODBUS register address for the second Data MS must be followed directly by the start register address for the third Data MS, etc.
- All Data MS, except the last Data MS, used for one command **must** be built with 24 DATs.

3.6.4 PC Program Layout

To control the data flow on the asynchronous communication link, you must build a PC program in the Advant Controller 400. The PC program receives status information from CI532V02. The flow control is maintained through a chain of SENDREQ PC elements, each corresponding to a Command MS to be transmitted (see Figure 3-26 and Figure 3-27).

Include all SENDREQ PC elements with Command MS addressed to the same PLC in the same chain to ensure a correct flow control to the MVI-MODBUS link. Use the PC program to control the Command MS if CI532V02 is used in master mode. A PC program is not necessary in slave mode.

The cycle time of CONTRM should be approximately 100 ms.

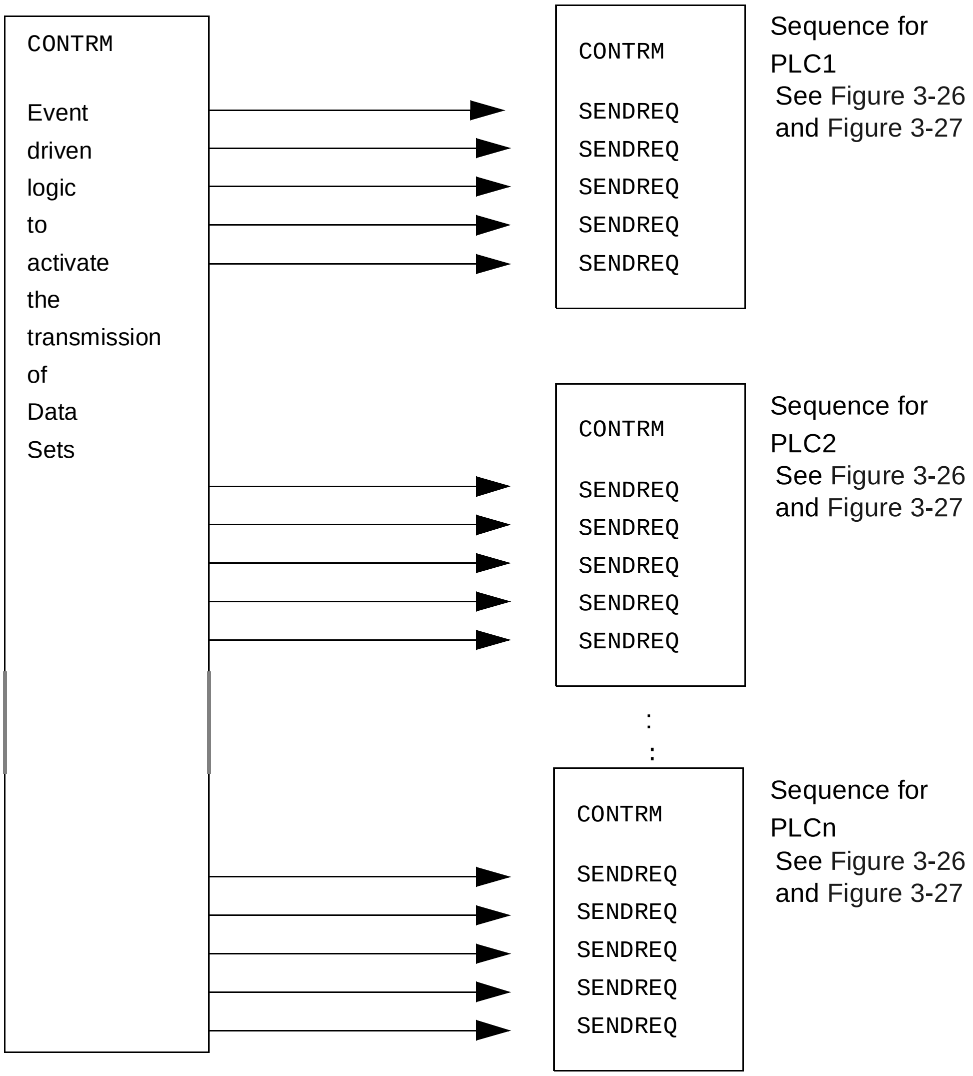


Figure 3-25. Overall PC Program Layout for MVI-MODBUS in Master Mode

3.6.4.1 Type Circuits for MVI-MODBUS Data Flow Control

Figure 3-26 shows a PC program type circuit which is used for data flow control on a MVI-MODBUS link. By linking several SENDREQ PC elements to each other with NXTBLK and PRVBLK, the order in which the data base elements are activated can be controlled. By using Link Status and Ready for Message status bits from the Status MVI Data Set to control the BLOCK terminal on the SENDREQ element, it can be assured that the CI532V02 submodule does not receive more messages than it can handle.

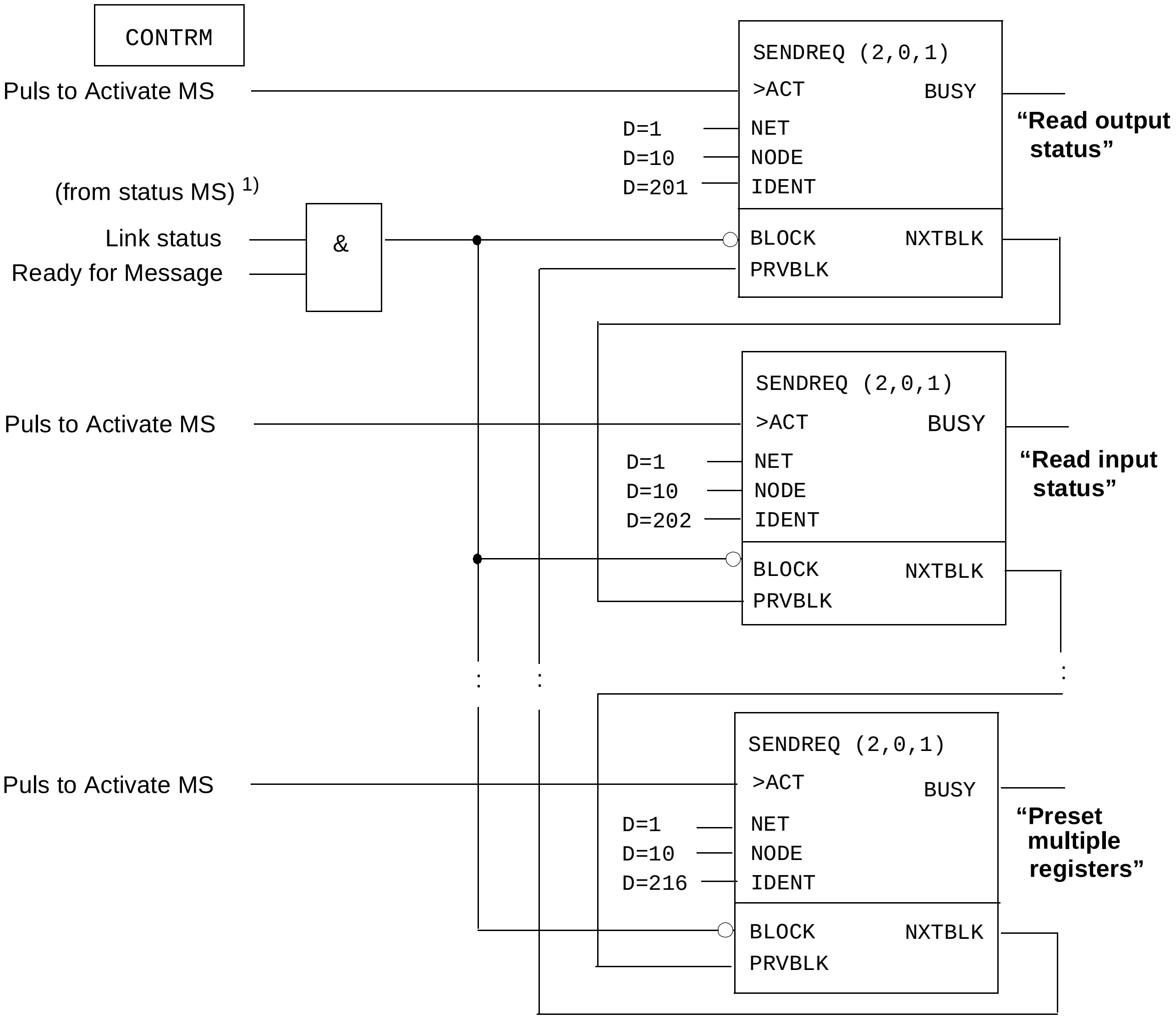
When ACT goes from 0 to 1, the MS with the identity given by NET, NODE and IDENT is activated once.

NXTBLK is true when sending of an MS is in progress. When sending is completed, it is set to false. When no sending is in progress, NXTBLK follows the value of PRVBLK.

PRVBLK is used together with NXTBLK to control the activation of the MS. No sending begins when PRVBLK is true. If sending orders are given at the ACT terminal during blocking by PRVBLK, the MS will be activated when PRVBLK is set to false.

No sending takes place when BLOCK is true. If sending orders are given at the ACT terminal during blocking by BLOCK, they are ignored.

Flow control of activation of MS is achieved by connecting the NXTBLK output of the first SENDREQ element to the PRVBLK input of next SENDREQ element. The NXTBLK output of this element is then connected to the PRVBLK input of the third SENDREQ element and so on. The NXTBLK output of the last SENDREQ element is connected to the PRVBLK input of the first SENDREQ element. Thus, the SENDREQ elements are connected in a chain, see Figure 3-26. With this PC program sequence, each SENDREQ element will activate its MS, one for each execution cycle, in the order they are linked together.



[1] Status is fetched from the Status MVI Data Set with IDENT = 3/13
for the PLC (in this example node=10), see Section 3.6.1.3, PLC Status MS
Ready for Message = Status1:VALUE6
Link status = Status1:VALUE

Figure 3-26. PC Program Sequence for Control of MVI-MODBUS in Master Mode

You can use this function block to multiplex different Register Addresses and number of registers into the Command MS DATs.

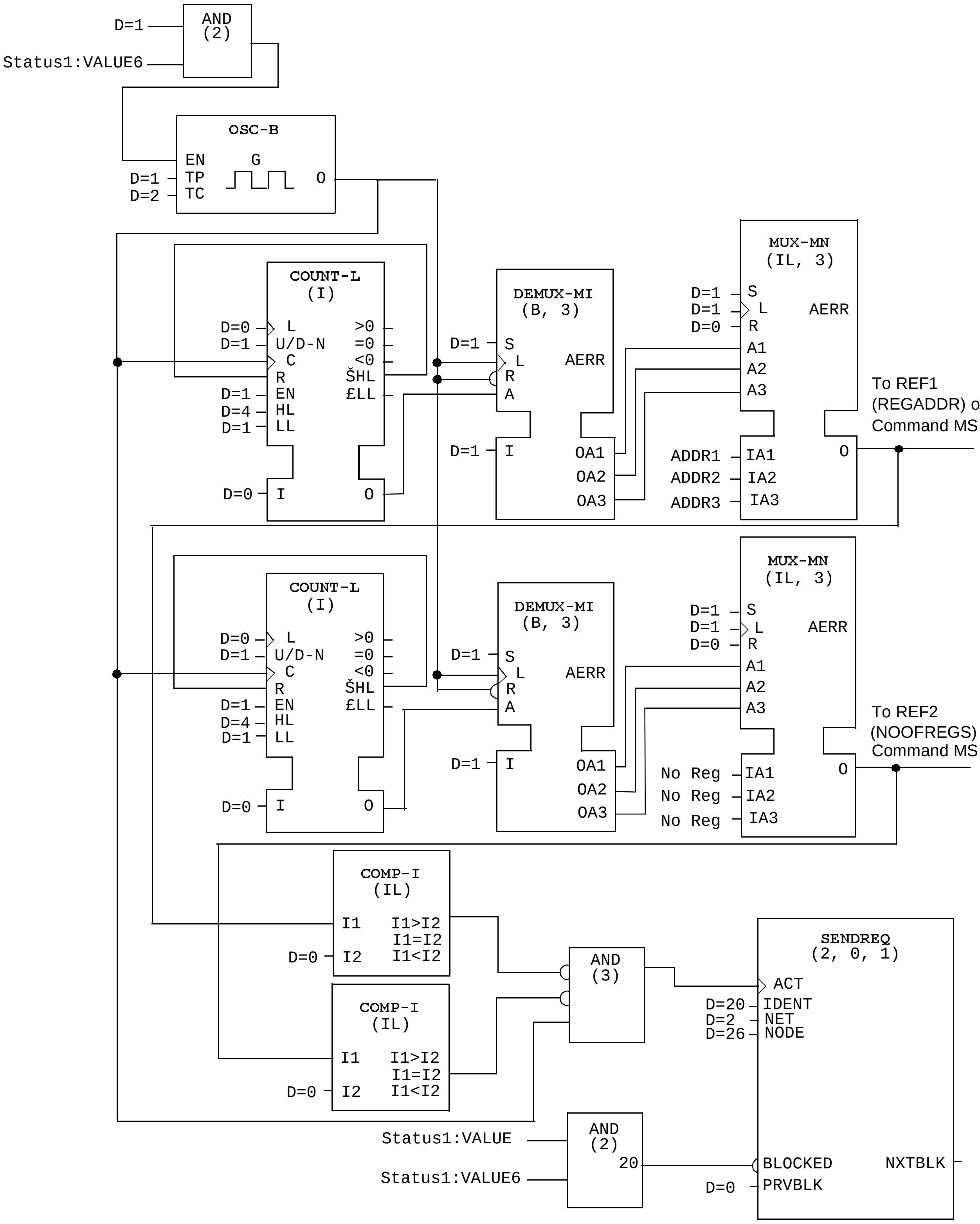


Figure 3-27. Function Block for Command MS

3.6.5 Redundant Configuration

To ensure availability of data communication when a cable or a communication unit fails, MVI-MODBUS can be duplicated. The Advant Controller 400 system software supervises both the communication lines in a redundant MVI-MODBUS configuration. The switch-over between the lines is handled automatically by the system software. The redundant MVI-MODBUS is based on two MVI-MODBUS handlers and a point-to-point connection.

You can implement the redundant MVI-MODBUS in two different ways:

- Use one submodule (CI532V02) with both ports used and connected to the same node, with different network numbers.
- Use two submodules (CI532V02) with one port on each submodule connected to the same node, with different network numbers.

Use redundant MVI-MODBUS only for point-to-point connections as delay times and time-out times are hard to predict in a multidrop environment.

To set up a redundant MVI-MODBUS configuration, you must:

- Build the **Configuration MS** (Line Characteristics MS, Network Configuration MS, PLC Status MS and Register Addresses MS) for both the ports. Configure the Configuration MS for both ports with the same parameters (the same values on the connected DAT elements).
- Also make the setup with the data base element **CI532** for both the ports.
- Since the **Data MS** and the **Command MS** are shared by the two redundant ports, make sure the Data MS and the Command MS have the parameter NET corresponding to the main port, see Section 3.6.5.1, Established Connection.

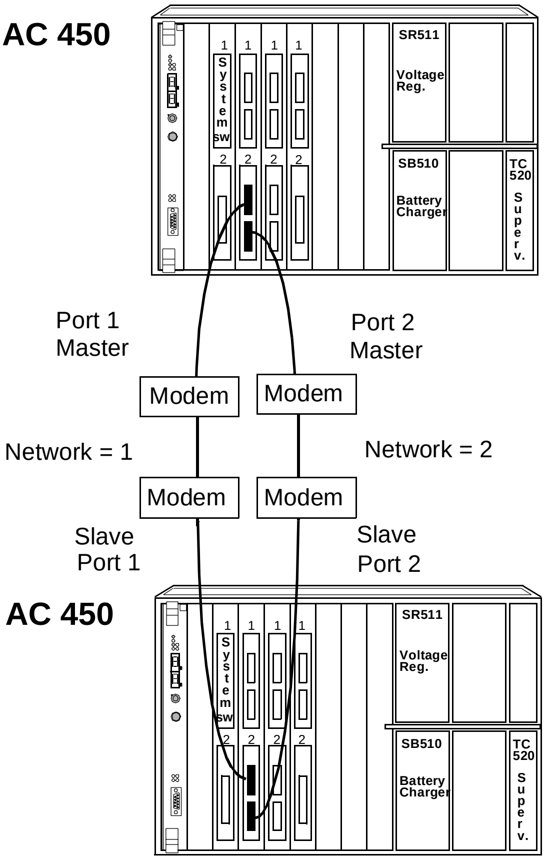


Figure 3-28. Example of a Redundant Point-to-point Connection.

3.6.5.1 Established Connection

When the MVI-MODBUS handler has established connection to the asynchronous communication ports, the system starts redundant. One handler is responsible for the data communication on the primary port and the other MVI-MODBUS handler is responsible for the standby communication (receiving and sending poll messages) on the secondary port.

3.6.5.2 Lost Connection

When connection to another node is lost (on the primary data communication port), the Advant Controller 400 switches the traffic to the secondary port. The standby MVI-MODBUS handler takes over the data communication. To get a fast switch-over, adjust some parameters in the Line Characteristics:

- **Adjust the Master poll time and the slave poll time (REF13)** to each other (defined in the MS for Line Characteristics). The master must maintain cyclic traffic on the ports to each node with at least the same time as the slave poll cycle time.
- **Adjust the number of retransmissions (REF12)** (defined in the MS for Line Characteristics).
- **Adjust the turnaround time (REF11)** for master and slave node (defined in the MS for Line Characteristics).

Recommended poll time values for point-to-point communication (for the data communication port and the standby port):

Master poll time = 2 s (for both ports)

Slave poll time = 3 s (for both ports)

The poll cycle time value is valid if:

Number of retransmissions ≥ 2

Master turn-around-time = 200 ms

Slave turn-around-time = 100 ms

NOTE

The recommended values are valid for the example of point-to-point communication given in Figure 3-29. It may be necessary to adjust the recommended values, depending on the type of PLC and configuration.

3.6.5.3 Re-established Connection

When the connection is re-established on the primary port, the Advant Controller 400 switches over the traffic from the secondary to the primary port. The MVI-MODBUS handler for the primary port takes over the data communication and the other MVI-MODBUS handler starts the standby (poll) communication on the secondary port.

3.6.5.4 Flow Control for Redundant Bus

When a redundant MVI-MODBUS is used, you must consider both ports' status for the flow control, see Section 3.6.1, MS for MVI-MODBUS Configuration and Section 3.6.4.1, Type Circuits for MVI-MODBUS Data Flow Control.
In this example, port two (2) is considered the backup port and port one (1) the main port.

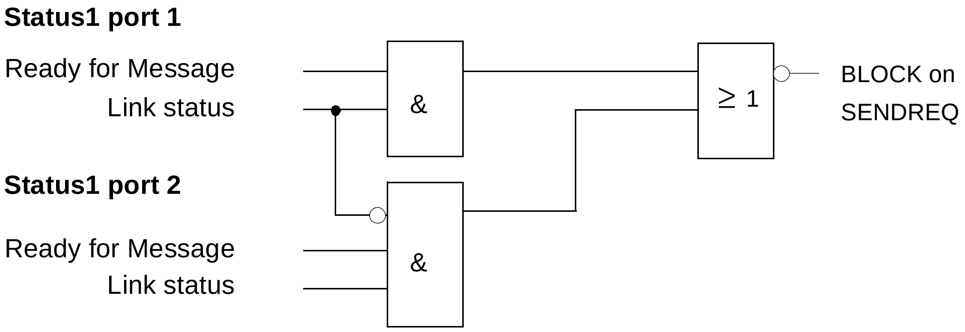


Figure 3-29. PC Program for Flow Control with Redundant Bus

Chapter 4 Runtime Operation

4.1 Product Operation

The Advant Controller 400 must be in runtime mode (mode P1, indicated on the front of the main processor module) to communicate on the MVI-MODBUS link. With the Advant Controller 400 in configuration mode (mode P2, indicated on the front of the main processor module), the communication is stopped.

4.2 Operating Overview

After start-up, and with the Advant Controller 400 in operation mode, you can perform the following operations:

- From the PC program for activation of commands and flow control
  - Activate/Stop sending of Data MS
  - Activate/Stop sending of Command MS (Read, Write and Status Request command).
  - Re-initiate a channel on the CI532V02 submodule by sending the Line Characteristics MS to the CI532V02 submodule.
  - Restart the CI532V02 submodule by setting/re-setting the terminal SERVICE on the CI532 data base element.
- The status information for the MVI-MODBUS link in the PLC Status MS can be displayed.

4.3 Runtime Tutorial

A Runtime Tutorial is not included in this manual. The reader must be familiar with application commands in the Advant Controller 400.

4.4 Operating Instructions

For a description of commands for control of the PC program and data base, please refer to *AMPL Configuration Advant Controller 400 Series Reference Manual*.

4.5 Runtime Operation Menus

Not applicable.

Chapter 5 Maintenance

5.1 Preventive Maintenance

Not applicable.

5.2 Hardware Indicators

The CI532V02 submodule has two LED indicators on the front:

- The green LED is lit when the database element CI532 for the CI532V02 submodule is correctly filled in and the CI532V02 submodule has received the Configuration MS for one port, see Section 2.2, Setup (the terminal IMPL and SERVICE must be set to 1 on the CI532 element).
- The red LED is lit when a fatal error is detected on the CI532V02 submodule.
  The LED is also turned at a reset of the submodule.

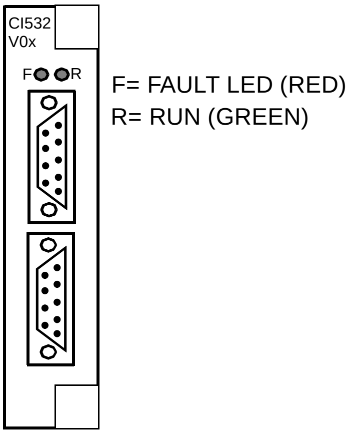


Figure 5-1. LED Indicators on CI532V02 Submodule

5.3 Error Messages

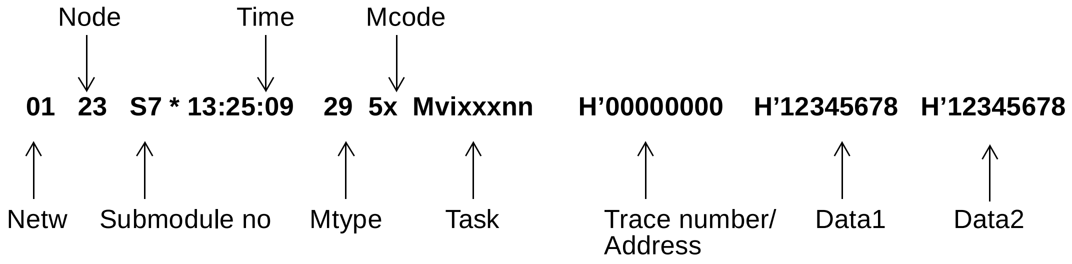
This part of the document lists all system messages that might be generated from the CI532V02 submodule. System messages from the Advant Controller 400 system software are not included. The MVI Data Set task CXAM000 can report a number of errors related to the MVI-MODBUS communication, MS not found, destination unreachable, channel to handler full and so on.
For translation of system messages from the Advant Controller 400, please refer to the *Advant Controller 410 User's Guide* or *Advant Controller 450 User's Guide*.

The error codes indicated on the database element CI532 is translated in the figure below.

Table 5-1. Error Codes from the Data Base Element CI532

Error Code	Interpretation
21	Duplicate node number on the network
22	More than one node number in the station
23	Station connected to more than one Control Network
25	Network number already used in the Advant Controller
31	Module not found or internal bus error
32	Not correct hardware identity on module
33	Start up of module failed
34	Suspected hardware error
35	Not correct software identity on module
36	Not correct module interface identity
50	Illegal submodule number
51	Illegal module position
52	Module position number already used in the Advant Controller
53	Two modules has the same submodule number

System message printouts on the engineering station have the following appearance:



```
01   23   S7 * 13:25:09   29  5x  Mvixxxnn    H'00000000   H'12345678   H'12345678
```

Figure 5-2. System Message Layout

All system messages have:

- Mtype = 29
- Task name = MVIxxxnn
  - xxx = Hdl if the MVI Protocol Handler reports the error
  - xxx= Stb if the MVI Protocol Stub reports the error
  - xxx = Mux if the MVI Protocol Multiplexer reports the error
  - nn = 01 for port one
  - nn = 02 for port two.

Table 5-2. Messages with Mcode = 54 and Task Name = MviHdlnn from CI532V02

Trace Number (Hexadecimal)	Parameter Description 1 = data1 2 = data2	Comments and Suggested Actions
00040005	1: File descriptor 2: -	Read from FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
00040006	1: File descriptor 2: -	Write to FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.

Table 5-3. Messages with Mcode = 55 and Task Name = MviHdlnn from CI532V02

Trace Number (Hexadecimal)	Parameter Description 1 = data1 2 = data2	Comments and Suggested Actions
00010002	1: - 2: -	Failed to create UART device. Reset the MVI module, if the problem persists, please contact ABB.
00010003	1: File descriptor 2: -	Initiate UART failed. Reset the MVI module, if the problem persists, please contact ABB.
00010004	1: - 2: -	Failed to open UART device. Reset the MVI module, if the problem persists, please contact ABB.
00010009	1: File descriptor 2: -	Parameterize UART failed. Reset the MVI module, if the problem persists, please contact ABB.

Table 5-3. Messages with Mcode = 55 and Task Name = MviHdlnn from CI532V02 (Continued)

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
0001000b	1: File descriptor 2: -	Failed to fetch event status from UART. Reset the MVI module, if the problem persists, please contact ABB.
0001000d	1: File descriptor 2: -	Failed to fetch modem status from UART. Reset the MVI module, if the problem persists, please contact ABB.
00020002	1: - 2: -	Failed to create watchdog timer device. Reset the MVI module, if the problem persists, please contact ABB.
00020004	1: - 2: -	Failed to open watchdog timer device. Reset the MVI module, if the problem persists, please contact ABB.
00020010	1: File descriptor 2: -	Failed to start watchdog timer. Reset the MVI module, if the problem persists, please contact ABB.
00040002	1: - 2: -	Failed to create FIFO device. Reset the MVI module, if the problem persists, please contact ABB.
00040004	1: - 2: -	Failed to open FIFO device. Reset the MVI module, if the problem persists, please contact ABB.
00040005	1: File descriptor 2: -	Read from FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
00040006	1: File descriptor 2: -	Write to FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
0005000f	1: Requested block size 2: -	Failed to allocate memory. Reset the MVI module, if the problem persists, please contact ABB.
00050012	1: - 2: -	Select failed. Reset the MVI module, if the problem persists, please contact ABB.
00060013	1: Node number 2: -	Illegal node number. The node number requested was not configured. Check the configuration and command data base elements.

Table 5-4. Messages with Mcode = 56 and Task Name = MviStbnn from CI532V02

Trace Number (Hexadecimal)	Parameter Description 1 = data1 2 = data2	Comments and Suggested Actions
00020002	1: - 2: -	Failed to create watchdog timer device. Reset the MVI module, if the problem persists, please contact ABB.
00020004	1: - 2: -	Failed to open watchdog timer device. Reset the MVI module, if the problem persists, please contact ABB.
00020010	1: File Descriptor 2: -	Failed to start watchdog timer. Reset the MVI module, if the problem persists, please contact ABB.
00020011	1: File Descriptor 2: -	Failed to cancel watchdog timer. Reset the MVI module, if the problem persists, please contact ABB.
00030004	1: File Descriptor 2: -	Failed to open transceiver channel. Reset the MVI module, if the problem persists, please contact ABB.
00030005	1: File Descriptor 2: -	Read from transceiver channel failed. Reset the MVI module, if the problem persists, please contact ABB.
00030006	1: File Descriptor 2: -	Write to transceiver channel failed. Reset the MVI module, if the problem persists, please contact ABB.
00030007	1: File Descriptor 2: -	Failed to close transceiver channel. Reset the MVI module, if the problem persists, please contact ABB.
0003000f	1: File Descriptor 2: -	Failed to allocate transceiver buffer Reset the MVI module, if the problem persists, please contact ABB.
00030016	1: - 2: -	Failed to fetch Host Information. Reset the MVI module, if the problem persists, please contact ABB.
00040004	1:- 2: -	Failed to open FIFO device. Reset the MVI module, if the problem persists, please contact ABB.
00040005	1: File Descriptor 2: -	Read from FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.

Table 5-4. Messages with Mcode = 56 and Task Name = MviStbnn from CI532V02 (Continued)

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
00040006	1: File Descriptor 2: -	Write to FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
0005000f	1: Requested block size 2: -	Failed to allocate memory. Reset the MVI module, if the problem persists, please contact ABB.
00050012	1: - 2: -	Select failed. Reset the MVI module, if the problem persists, please contact ABB.
0005001f	1: - 2: -	Start of protocol handler failed. Reset the MVI module, if the problem persists, please contact ABB.
00050020	1: 10 2: Semaphore ID	Semaphore operation failed. Reset the MVI module, if the problem persists, please contact ABB.
00060013	1: Node number 2: -	Illegal node number. The node number requested was not configured. Check the configuration and command data base elements.
00070014	1: Data1 = xxyyyyyy xx = 1: Duplex (REF7) xx = 2: Speed (REF3) xx = 3: Character Length (REF4) xx = 4: Stop Bit (REF5) xx = 5: Parity (REF6) xx = 6: Illegal PLC type (REF1) xx = 7: Illegal Modem type (REF16) xx = 8: Illegal MS identity yyyyyy = parameter value 2: -	Illegal Line Characteristics parameter. Check the corresponding DAT value in the Line Characteristics MS. Restart the CI532V02 submodule after change of Line Characteristics MS.

Table 5-4. Messages with Mcode = 56 and Task Name = MviStbnn from CI532V02 (Continued)

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
00070018	1: MS identity 2: -	Time-out waiting for Configuration MS. Create the Configuration MS with ident=Data1, and fill in the connected DAT references. See Section 3.6.1, MS for MVI-MODBUS Configuration
00070019	1: PLC register address 2: Number of registers requested	Illegal data request. The Register Addresses MS must contain the register address = Data1. Fill in the correct register address and restart the CI532V02 submodule. The Data MS corresponding to the PLC register address must also be configured in the Advant Controller 400. If the PLC register address is not to be used, then check the DAT values for the Command MS or the command from the PLC.

Table 5-5. Messages with Mcode = 57 and Task Name = MviMux from CI532V02

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
00030002	1: - 2: -	Failed to create transceiver channel. Reset the MVI module, if the problem persists, please contact ABB.
00040004	1: - 2: -	Failed to open FIFO device Reset the MVI module, if the problem persists, please contact ABB.
00040005	1: File Descriptor 2: -	Read from FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
00040006	1: File Descriptor 2: -	Write to FIFO failed. Reset the MVI module, if the problem persists, please contact ABB.
00070015	1: MS identity 2: -	Illegal DSX Signal received. Check the identity (m_code) for all Configuration MS and Command MS.

Table 5-6. Messages with Mcode = 58 and Task Name = MviHdlnn from CI532V02

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
00010005	1: File Descriptor 2: -	Read from UART failed. Reset the MVI module, if the problem persists, please contact ABB.
00010006	1: File Descriptor 2: -	Write to UART failed. Reset the MVI module, if the problem persists, please contact ABB.
0001000b	1: File Descriptor 2: -	Failed to fetch event status from UART. Reset the MVI module, if the problem persists, please contact ABB.
0001000c	1: 000000xx xx = 1: Assert DTR xx = 2: De-assert DTR 2: -	Failed to assert/de-assert modem signal. Reset the MVI module, if the problem persists, please contact ABB.
0001000d	1: File Descriptor 2: -	Failed to fetch modem status from UART. Reset the MVI module, if the problem persists, please contact ABB.
0001000e	1: File Descriptor 2: -	Failed to cancel read descriptor. Reset the MVI module, if the problem persists, please contact ABB.
0001001e	1: File Descriptor 2: -	Failed to flush UART. Reset the MVI module, if the problem persists, please contact ABB.
00020004	1: - 2: -	Failed to open watchdog timer device. Reset the MVI module, if the problem persists, please contact ABB.
00020010	1: File Descriptor 2: -	Failed to start watchdog timer. Reset the MVI module, if the problem persists, please contact ABB.
00020011	1: File Descriptor 2: -	Failed to cancel watchdog timer. Reset the MVI module, if the problem persists, please contact ABB.
00050012	1: - 2: -	Select failed. Reset the MVI module, if the problem persists, please contact ABB.

Table 5-6. Messages with Mcode = 58 and Task Name = MviHdlnn from CI532V02 (Continued)

Trace Number (Hexadecimal)	**Parameter Description** **1 = data1** **2 = data2**	**Comments and Suggested Actions**
00070014	1: PLC register address 2: Number of registers requested	Illegal register address. The register address has been used with wrong function code. Check the register addresses in your Command MS. See Table 3-10 for allowed register addresses.
00070019	1: PLC register address 2: Number of registers requested	Illegal Data Request. The Register Addresses MS must contain the register address = Data1. Fill in the correct register address and restart the CI532V02 submodule. The Data MS corresponding to the PLC register address must also be configured in the Advant Controller 400. If the PLC register address is not to be used, then check the DAT values for the Command MS or the command from the PLC.
0007001a	1: - 2: -	Illegal data value reported from PLC (MODBUS Exception Response Code 3.). The value referenced in the data field is not allowable in the addressed slave location.
0007001b	1: Function code 2: -	Illegal Function code reported from PLC (MODBUS Exception Response Code 1), or a Function code not supported by CI532V02 received from the PLC.
0007001c	1: - 2: -	Hardware error reported from PLC (MODBUS Exception Response Code 4 or 8.).
0007001d	1: PLC register address 2: Number of registers requested	Illegal data address reported from PLC (MODBUS Exception Response Code 2.). The address referenced in the data field is not an allowable address for the addressed slave location.

5.4 Fault Finding and User Repair

If you follow the instructions in Chapter 2, Installation and in Section 3.6, Configuration of MVI-MODBUS Application Data Base and PC Program and still do not have a correctly working communication link, please check the following:

1. Are Modems and Cables correctly Set-up?

The CI532V02 must receive the correct modem signals. When you select full duplex mode for the modem signals, the signal Data Set Ready (DSR), Data Carrier Detect (DCD) and Clear to Send (CTS) must be set. In half duplex mode the DSR. must be set and DCD and CTS toggle between 0 and 1.

Current DSR, DCD and CTS values are available in the database element CI532.
Note that displayed values from the CI532 element on the engineering station are not synchronized to the actual value change of the signals; short pulses may not be displayed.

The modem signals are set up by the modem or, in full duplex mode, you can wire them in the 9-position connector on cable TK577 or, in the 9-position connector on the MVI side on cable TK595 (see Figure 2-5).

2. Is the CI532 Data Base Element correctly Filled in?

You must define the same node number for all the communication boards in an Advant Controller 400 node. All network numbers in the Advant Controller 400 node must be unique (for CI532V02 1-9).
If the network number or node number for any of the communication modules in the Advant Controller 400 is changed after the start-up of the node, the Advant Controller 400 must be COLD STARTED. Connect an engineering station to the Advant Controller 400 and make a DUAP, press ENTER on the main CPU with start-up switch in "CLEAR" position and make a LOAP.

3. Check the Data Base and PC Program Application.

a. Have the Configuration MS (Line Characteristics MS, Network Configuration MS, Register Addresses MS and PLC Status MS) been sent to the CI532V02 submodule? The VALID flag on these MS is set to 1 when the MS is successfully transferred to the module.

   The Record number on the CI532 data base element defines the submodule number used for the NET terminal on the Configuration MS. The submodule numbers are 7 to 11 in Advant Controller 450 and 7 and 8 in Advant Controller 410.

b. Data MS for the actual data transfer must be defined. In order to update only a part of a MS, there must always be a sending MS (IDENT = 1-96) corresponding to a receiving MS (IDENT = 101-196). The sending and receiving Data MS must be connected to the same DAT elements.

c. In master mode, the Command MS and the PC program with SENDREQ-elements for the flow control must be built and started.

4. Are there any System Messages reported in the Advant Controller 400?

Check system messages by connecting an Advant Station 100 Series Engineering Station to the Advant Controller 400. Also check the system messages when you restart the CI532V02.
To start the module, set the terminal SERVICE to 0 and back 1 in the CI532 element.
All configuration errors are reported at start-up. Error messages with task name MVIxxx and mtype 29 are translated in Section 5.3, Error Messages. Note that some errors are only reported once.

5. What Status Bits are set in the PLC Status MS?

VALUE (bit0) is set when the Advant Controller 400's connection to the PLC is established, see Section 3.6.1.3, PLC Status MS.

If you know the answers to the following questions, further analysis will be easier:

a. Are modems and cables installed as described in the *ABB Master Installation Rules* manual? Pay particular attention to the power supply and connection to signal ground.

b. How is your control system configured? A block diagram with all node and network numbers is useful. Note also the type of PLC, the master and slaves on the link and the type of modem you are using.

c. Have you made any significant changes in your configuration (for example, new communication board(s) added, new modems)?

d. Is it possible to repeat your problem?

e. Have you found any way to circumvent the problem?

f. Have you made any other observations related to the problem?

A test tool for monitoring the status of the V.24 leads is also useful for further analysis.
The test tool shows the status, with LED indicators, of the modem signals, data transmission (TD) and reception (RD). When an analysis of the data flow on the MVI-MODBUS link is necessary, you need a Serial Line Analyzer that monitors and stores the signals sent on the link.

Appendix A Hardware Module

A.1 CI532V02 - MODBUS Communication Interface

The CI532V02 - MODBUS Communications Interface has:

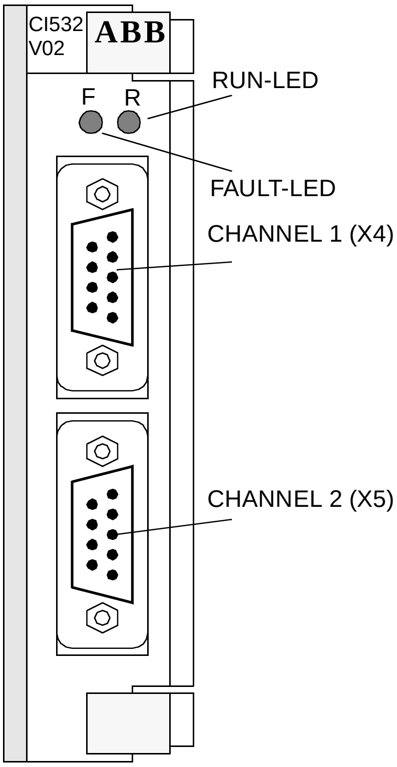
- Two RS-232-C communication interfaces
- Modem support

Description

CI532V02 - MODBUS Multi Vendor Interface is a submodule destined to the submodule carrier SC510 and SC520 in Advant Controller 450 and Processor Module PM150 in Advant Controller 410.
The two RS-232-C communication interfaces are used for communication with the Gould Electronics protocol MODBUS (RTU and ASCII). The communication channels support communication speed up to 19.2 kbit/s which is the limit set by the system software.
Both channels can run at this speed simultaneously.

The maximum communication distance without modems is 15 m.
The modem signals which are supported can be found in Table A-1 below.

Communication pins are short circuit proof.



Front View

Technical Data

Indicators

LED R, Run (green) on module front. Indicating module running normally.

LED F, Fault (red) on module front. Indicating a fatal error detected on the CI532V02 module. The LED is also turned on at reset of the module.

Jumpers

The board contains one jumper for special purposes. In normal operation always keep the S1 in position 3 - 4 (“parking place”). The component and position indications are found on the printed circuit board.

Connectors

Serial channels 1 and 2 connectors (X4 and X5):

Connector type	9-pole male DSUB (DE9P)
Placement	On module front
Pin designation	See Table A-1 below

Table A-1. Pin Designation for Channel 1 and 2, Connector X4 and X5

Pin	Short	Description
1	DCD	Data Carrier Detect
2	RD	Receive Data
3	TD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator

Power Supply

5 V	typical	400 mA
	max.	670 mA
24 V	max.	40 mA
Power loss (heat)	typical	3 W

Mechanical Data

Module size:	Occupying one submodule slot (H = 95 mm, L = 140 mm connectors not included).
Weight:	0.13 kg

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